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SCARBOROUGH

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SCARBOROUGH

AS

A HEALTH RESORT:

ITS PHYSICAL GEOGRAPHY, GEOLOGY, CLIMATE, & VITAL STATISTICS,

WITH HEALTH GUIDE MAP, &c.,

BY

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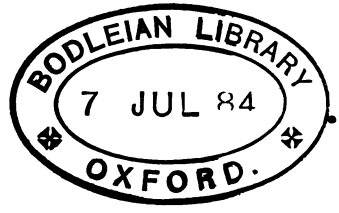

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PREFACE.

A lecture having been delivered at the Old Town Hall, by Mr. Alfred Haviland, on the 31st of July last, on "Scarborough as a Health Resort," illustrated by large maps showing the Physical Geography of the town, the Geographical distribution of Consumption and other diseases in England and Wales, and diagrams explaining how the peculiar physical features within and around the borough tended to influence its climate, and render this watering place one of the most suitable for the residence of the consumptive; the Sanitary Committee of the Corporation, after hearing Mr. Haviland's proposition to complete the map in such a manner as he had described in a letter to me, and to furnish a memoir descriptive of it, resolved to recommend to the Council the purchase of the said map for the purpose of publication, in such a form as to serve as a "Health Guide Map for Scarborough."

I was induced to recommend the Sanitary Authority to secure Mr. Haviland's map and descriptive memoir, because it is desirable for all purposes connected with the Sanitation of the town, to have an official map of the borough, which should not only show, on a proper scale, the streets, roads, public buildings, etc., but those physical features which have such a marked influence on the climate of this Health resort.

Besides which, I felt that it was desirable, for the benefit of the town, and the public generally, that the climate of Scarborough should be more widely known, owing to its well proved suitability as a residence for persons predisposed to consumption and other diseases.

The map that the author of this memoir has constructed, is intended to show the different aspects, levels, and the position of the several protective heights in the town; the prevalent winds for the months, seasons, and the whole year, by means

of wind charts; the mean temperatures of the sea and air for each month, the daily range of temperature, the maximum and minimum temperature of the air for each month; the fluctuations of the atmospheric pressure, and the rainfall; are all represented by diagrams round the map, and thus, even those not acquainted with the town will be enabled to select the most appropriate aspects for residence, and the most suitable time of the year for their visit: besides which, the map is so constructed as to be of essential service to the medical profession at large, enabling practitioners to obtain at a glance, all the most important information relative to its climate, its physical geography, and its suitability for certain diseases such as consumption—points of essential importance to the welfare of invalids and the reputation of Scarborough.

J. W. TAYLOR, M.D., D.Sc.,
Medical Officer of Health.

INTRODUCTION.

THE GEOGRAPHICAL DISTRIBUTION OF DISEASE, A PART OF ITS NATURAL HISTORY; THE GEOGRAPHICAL DISTRIBUTION OF CONSUMPTION (PHTHISIS) IN ENGLAND AND WALES.

THAT part of the study of the Natural History of Disease, which treats of its geographical distribution, has been much neglected; hence a powerful aid in the preventive treatment of many of the grand causes of death has been allowed to remain unused, from a want of the knowledge of its existence. When medicine first started into being as a science, under the well directed genius of its great father, Hippocrates, that branch of medical knowledge, known now as *Preventive* medicine, was ushered into the world by this arch-physician, at the same time as its twin-sister, *Curative* medicine; and had the same fostering care been bestowed upon it as it enjoyed more than two thousand years ago at the hands of the enlightened medical teacher, and practitioner of Cos, it would have, in the interval of lost centuries, saved an incalculable number of lives, and have preserved the fame of its companion from the charlatanry of the priest-craft of the earlier, and the leechcraft of the later periods, that have intervened between the death of Hippocrates and the present day.

Health resorts are generally regarded more from a curative and recreative than from a preventive point of view, but as nearly all these places are becoming more and more selected as fit sites for educational purposes, it is of great importance that those resorts, which are eminent on account of their natural beauty, general healthfulness, easy access from the great centres of commercial industry, and abundant means for the amusement of all classes of visitors, like Scar-

borough, should be well studied with regard to their elegibility for the prolonged residence of the young, and those having charge of them, especially in cases where there is a tendency to what may be strictly termed the national disease of the youth of England—Consumption.

In 1868, I commenced a series of investigations as to the geographical distribution of the principal diseases in England and Wales: commencing with the distribution of Heart Disease, Consumption, Cancer, Fevers, &c., which I illustrated by maps, the first three of which I exhibited at my lecture at the Old Town Hall, in Scarborough, in July last. In this introduction I propose to give a short summary of the results of my enquiries into that part of the natural history of Consumption (Phthisis) which involves its geographical distribution in England, for the simple reason that Scarborough will exemplify some of the principal conditions of climate that are favourable in the *preventive* treatment of this disease. In the first place I have shown in my work on this subject, that persons having any hereditary taint of consumption in the lungs cannot stand the full *force* of prevailing winds from whatever direction they blow, and have proved that, on this account, the highest mortality in England is *always* to be found in those parts that, from geographical position and physical conformation, give free access to the winds, allowing them to pursue their course unrestrainedly. My map of the distribution of this disease distinctly shows how the groups of high mortality are always to be found wherever these conditions are obtained.

From the North to the South of the *Western* watershed of Wales, we find an almost unbroken series of high mortality districts from the coast line to the backbone of the Principality, separating the Eastern from the Western watershed; the latter of which is characterised by a tract of country, sloping gradually to the sea, and furrowed by the courses of short torrential rivers, having the axes of their valleys in the direction of the prevailing sea winds. On this side therefore we find everything favouring the free rush of the winds from the sea coast up to the summit of the parting ridge: here then is experienced the winds' full *force*; true it is that they are *pure* as well as *forcible*; their *purity* however does not

avail the weak-lunged while associated with their fatal *force*; hence it happens that the lung-tainted are singled out and made to fall victims before their ruthless power. Let us now cross over the water-parting, the back-bone of Wales, and descend into the Eastern water-shed, where the valleys are watered by the Severn and its almost innumerable tributaries, where the might of the westerly winds has been destroyed, and their *purity* alone left to descend and soothe the very lungs that would have perished on the western watershed; hence it is that in this vast valley from North to South, and from West to East, we find none but low mortality districts, except when social causes predominate and counteract all the benign influences of the well tempered climate.

If we now cross over England to the comparatively flat area bordering the sea of the Eastern counties, there again we find a large and important group of high mortality districts, and coincident with this, every facility afforded the winds, including the East, of rushing with unrestrained force over this large tract of country. We thus find that whether the land be shelving or whether it be flat, so long as no resistance is offered to the winds, their *force* quality exerts its malign influence on all tainted with this national disease when exposed to it. I will now direct attention to those parts of England, where the winds have not all their own way on reaching the coast, when after crossing the level surface of the seas, -at more than express train railway speed—they meet with insuperable barriers to their progress in the form of high precipitous cliffs, which divert both their *course* and their *force* upward, and thus protect the land behind them from the latter, whilst they enable it to enjoy their purity.

The precipitous coast lines of the two opposite sides of England, viz.: the extreme North East and South West, afford a happy contrast to the effects of the shelving, and the flat tracts of Western Wales, and the Eastern counties respectively. In fact it was the extremely low mortality from consumption within the protective range of the precipitous cliffs of the North Riding of Yorkshire, that first led me to enquire minutely into the cause of the exceptionally low mortality from consumption in Scarborough and the neighbouring districts. In the colored map which I have published and with which I

illustrated the lecture alluded to, the *high* mortality districts are colored *blue* in different shades, the deepest blue representing the highest death rate from this cause; whilst the districts, where this disease was comparatively scarce or *below* the average, were colored *red* in different shades, the deepest red indicating the *lowest* mortality from consumption to every 10,000 of the population living. By these means the map was shown to be divided into a series of well defined groups of districts, appealing to the eye at once, and showing at a glance, where the conditions of climate, physical geography, and social life, either favoured the development and extension of consumption, or checked the one and prevented the other. If we take the whole coast line of England and Wales, we shall find as a rule, without an exception, that the districts immediately under the protective influence of high precipitous cliffs, have a low death rate from Phthisis, whether they lie behind the cliff bound coast of North Devon, or those of Yorkshire; it is a fact however, that the largest group of the lowest mortality, is to be found on the coast of the North Riding of Yorkshire; and the next largest in the South West of Devonshire, where the physical conditions are similar.

That precipitous cliffs do break the force of the winds in the manner I have described was forcibly impressed on my mind many years ago, whilst on a visit at Eastbourne. One day when it was blowing a gale from the south west, I started from the beach near Sea Houses, (where I could hardly stand and with difficulty keep my hat on,) and walked up to the Coast Guard Station on the top of Beachey Head; whilst ascending I began to congratulate myself that the wind was lessening in force, as I had less and less difficulty in contending with it as I approached the summit; on reaching the flag-staff I was surprised to find what I thought was a sudden lull in the gale, for I was able to light a common vesta match and use it without difficulty: at this time I was at some little distance from the over-hanging summit; in a few seconds however I was standing on the very edge of the cliff, and on looking over it was astonished to find a tremendous current of air travelling *upwards*, which for a moment took away my breath, and blew my hat off instantly; it fell, however, immediately behind me, and whilst picking it up was surprised

to find that another lull, as I thought, had taken place. I looked over again, taking however the precaution to hold my hat well on, and immediately experienced the same violent upward current of air, which again nearly took my breath away. Within a few feet of the edge I lighted and used another vesta; I was in a calm, and on looking down on the little village of East Dean, I saw the smoke from the cottages lazily pursuing a nearly opposite course to the gale.

The phenomenon just described is a perfectly simple and natural one, and is observed whenever similar conditions are present. We, as a rule, forget when thinking or speaking of air currents (winds), that they are regulated by the same physical laws as water.

I will now endeavour to explain how precipitous cliffs affect the climate of adjacent districts and renders it so suitable in the preventive treatment of consumption.

Before doing so I will enumerate some of the characteristic cliffs which skirt the coast of the North Riding from Flamborough Head to Saltburn. This rock-bound coast consists of Flamborough Head, Speeton cliffs, Gristhorpe cliff (275 ft.), Redcliff (280 ft.), Osgodby Hill Top (300 ft.); the cliffs on which Scarborough stands between one and two hundred feet above the sea level, the Castle Hill cliff (285 ft.), Cloughton cliffs, the Stainton Dale cliffs, of which the old Peak, over six hundred feet high, is so prominent a land mark from the sea, the Hawkser cliffs, those of Whitby surmounted by the ruins of its beautiful Abbey, the Kettleness cliffs, where the great alum works once existed, over-looking Runswick Bay, the old Nab, south of Staithes, the Rock cliffs north of the Boulby and south of the Lofthouse Alum Works, and the Hunt cliff, south of Saltburn; all of which have been well described and illustrated by the late lamented John Phillips, F.R.S., who so loved Yorkshire and the coast of Scarborough as never to tire of describing their beautiful, physical, geological and climatical characteristics.

A diagram on the map shows how these cliffs act as breakers of the *force* of winds; it represents in profile a cliff such as those on which Scarborough is built. The arrows indicate the direction of the wind from the sea, and what takes place when it strikes against the rock as against a wall.

In the first place it must be remembered that a sea wind travels to the coast over a *level* surface; it rushes therefore straight at the opposing barrier with all its force, and being unable to make it yield, it yields itself and is deflected up the face of the cliff with a power that sends it considerably above the summit of its opponent, and with such power as to be in its turn a barrier to those higher currents of air which accompany it. The diagram will make my meaning clear: the arrows are each represented as having two halves; one, that of *force*; the other, that of *purity;* in the contest with the cliff the former is deviated, whilst the latter after a while descends without its companion and acts as we have seen in the vale of the Severn, and on the town and neighbourhood of Scarborough.

Elevated as Scarborough is on a platform between two and three hundred feet immediately above the sea, it enjoys all the advantages of being protected in the manner I have just pointed out; moreover it will be seen that the force of the land winds are broken by the elevated masses (such as Oliver's Mount and Scamer Moor) both within and without the borough boundary, without any impediment to free ventilation: indeed this is an all important advantage, for towns can be too well protected by heights; and when this is the case ventilation is obstructed, and all the disadvantages of the valley system experienced.

It will be amply shown in the sequel that the other climatic characteristic features, so essential in the preventive and curative treatment of consumption, are to be found in this resort: its peninsular position ensures it an equable temperature, as proved by the small annual and daily range of the thermometer; whilst the bracing character of its air gives life and tone to all who breathe it.

Before concluding these introductory remarks, I must acknowledge with my best thanks the ready assistance that was accorded to me by the Mayor and Town Council during my investigation. At their instance I had placed at my disposal all that I required to facilitate my enquiry.

To their indefatigable, experienced, and resolute Medical Officer of Health, Dr. John W. Taylor, D.Sc., I owe much for the open manner with which he at once received my proposition

to redeem a promise that I made when I paid my first visit to Scarborough in 1879, viz: to investigate the climate of Scarborough, especially in relation to its preventive power in cases of consumption. Everything concerning the health of the town he laid at my disposal, and in thanking him for the aid he has so frankly accorded to me, I must congratulate the Scarborough people in having so efficient a Medical Officer, and one who takes so genuine a pleasure in his work and is so jealous of the fair fame of the town.

To the excellent Borough Surveyor, Mr. Joseph Petch, I am also much indebted for the immense trouble he took in showing me everything I desired to see, whilst engaged in studying the physical features of the town and neighbourhood in their relation to the climate: his thorough knowledge and love of his work: his sound common sense and practical experience, made the study of Scarborough, interesting as it was, doubly so, and I am pleased to acknowledge how much valuable assistance he rendered me whilst visiting the Moorlands, the Wolds, and the Derwent country. Whilst constructing the large map of the Physical Geography of Scarborough I received the most valuable assistance from Mr. Petch. Scarborough was entirely re-surveyed for me by Mr. Petch's assistant, Mr. E. Hildyard, to whom I wish to record my thanks for the efficient manner in which he fulfilled my directions as to the planning of the *contour lines* and thus materially contributed to render the map, which accompanies this memoir, what I hope it will prove, not only interesting, but instructive and useful to the public, and medical profession.

SCARBOROUGH.

SECTION I.

Name and Geographical Position, &c.

THIS ancient town and modern sea-side watering place derives its name from the grand characteristic cliffs which stretch into the North Sea from the mainland, and was at an early period, 1136 A.D., in the reign of Stephen, surmounted by a Castle, the beautiful ruins of which still remain to attest its Norman origin and interest all who see them. The etymology of the name therefore is simple, as it is derived from *Scar*, a cliff, and *Burg*, a Castle. "The Castled Cliff" or "The Cliff with the Castle."

Scarborough is situated on the North East coast of England, in the North Riding of Yorkshire, between 54° 15' 0" and 54° 17' 15" Lat. N. and 0° 22' 25" and 0° 26' 24" Long. W.

As we shall find that the geographical position of Scarborough is important when we discuss its climate, I shall here enter into further details for reference, when we are considering the sources of some of the winds which prevail here during the spring months, and the capabilities of its climate for the culture of certain ornamental trees, which I advised, in 1879, to be planted wherever practicable, as a fit clothing of a site already proved to be so desirable as a resort for the consumptive. Scarborough is opposite the Schleswig-Holstein coast, which is separated from it in a due *easterly* direction by 370 miles of sea. In a *North Easterly* direction this resort has opposed to it, *The Naze*, which is the most south-westerly point of Norway, and distant from it about 385 miles; between this last point and the extreme north point of Denmark in a North East by East direction, Scarborough has before it an expanse of 525 miles of sea, stretching from its shores, through the Skäger Rack to the coast of

Görthenburg in Sweden, west of the important Lake Verner. Again, Denmark at its greatest width (56° 30' Lat. N.) is only 92 miles across, and this is the greatest breadth of *land* that separates the Cattegat from the North Sea; between which and the Baltic, the Cattegat is the connecting sea; so that from all the points between the North East and the East there is a large sea area, which has an important influence on the climate. Scarborough lies a little to the North of the parallel in which the Island of Heligoland lies, but is just opposite the mouth of the river Eider, which drains that part of Schleswig-Holstein, separating the Baltic from the North Sea.

Scarborough lies about 5 geographical miles to the South of Dantzic, (54° 21' N. Lat.) a station which Heer has made use of in estimating the northern limits of the growth of some trees.

From the *North North East* to the *North*, Scarborough has an unlimited expanse of ocean, reaching to the Arctic regions, the temperature, however, of which is modified by the Gulf Stream, which sweeps past the North Western coasts of the Shetland Islands and Norway; it is therefore *nearer* the influence of this current of warm water than any of the sea-side health resorts to the south on this coast.

From the East to the South East, Scarborough is confronted with the coast of the Netherlands, having an average of 250 miles of sea between it and that part of the continent of Europe.

From the North to the North-by-West it looks towards the same unlimited sea as it does from the *North North East* to the *North*: from the North by West, however, to the North West by West it looks towards the North Riding, Northumberland, Scotland, and the Atlantic Ocean: from North West by West to West by North it looks towards the West Riding, Cumberland, the North Channel, and the Atlantic; and from this point to *West South West*, it is flanked by England, St. George's Channel, Irish Channel, and Ireland: from this point to the South East, England is the only land that separates it from the English Channel and the Atlantic Ocean. Scarborough lies on a more southerly parallel than the Lake District of Cumberland, of which Windermere and Coniston Water are the most southern.

As regards the Isle of Man the mean Lat. N. 54° 16' would as nearly as possible pass through its centre, the highest part of Snaefell (54° 15' 47") at an altitude of 2,033·7 feet above the sea level, midway between Ramsey, 54° 19' 25" and Douglas, 54° 8' 48" Lat. N. Scarborough is not quite 3 geographical miles North of Peel. Under "climate" I shall be able to compare the difference in the prevalence of the winds at these two points. Scarborough lies on the same parallel that the Petchekupan River does, which empties itself into the Jouktoke Inlet on the coast of Labrador.

SECTION II.

Description of the Physical Geography of Scarborough as shown by the Map; its Aspects, Altitudes, and Relative Position with regard to surrounding Localities.

ANCIENT Scarborough was originally built upon the South side of the isthmus, which connects the Castle Hill with the mainland, and it is probable therefore that the peninsular position of the town, rendered its inhabitants a healthy and hardy people, healthier and hardier perhaps than their more inland neighbours, who had their homes in the beautiful valleys to the West.

Modern Scarborough, probably with the prestige of the healthiness of the old town, has grown to be a health resort; from a stronghold against human invaders it has grown to be a stronghold against the worst of all invaders—disease.

The map which illustrates this memoir, shows by the contour lines and distinctive shadings, that the greater, the most important, and the most beautiful part of Scarborough, stands upon a site abruptly elevated above the mean sea level

more than a hundred feet, and crowns a range of precipitous cliffs, which almost encircles it from the little beck to the South of "White Nab," to the point where it has been cut through by the rivulet, which forms the natural boundary of the North Western portion of the borough, and falls into the sea at Peasholm. These cliffs as we shall presently see, are not only interesting features in the physical Geography and Geology of Scarborough, but most important agents in the production of that climate, which I have shown in my introductory remarks, to be essential in the preventive treatment of consumption.

The boundary lines of the Parliamentary and Municipal Borough of Scarborough, have been for the most part determined by natural features; on the North, the East, and the North East sides, the North Sea, with its shore and overhanging cliffs, defines its sea-ward limits; whilst a portion of the South West and the whole of the North West limits are marked by the course of the rivulet, which takes its rise in springs that issue at the head of the valley between Seamer Moor and Stepney Hill, just below, and to the North West of the road that leads from the Forge Valley through East Ayton to Scarborough, at the point where the borough boundary is crossed. This stream, called, at one portion of its course *Newlane Beck*, takes a tortuous route, first to the North West and then to the North East along a well wooded ravine, the sides of which at Barrow cliff, reach an altitude of 150 feet, below which it is known as *Peasholm Beck*, and falls into the sea at Low Peasholm.

The streamlet which marks the extreme portion of the Southern boundary, has not had a name given to it, so far as I can ascertain; it rises on the East of the Southern part of Weaponness (Oliver's Mount) and at the foot of Knox Hill, it then takes a nearly straight course to the East, through a beautiful ravine, until it reaches the sea to the South of White Nab. This stream or beck is interesting apart from the beauty of its course, for as you stand on that part of Weaponness which overlooks its route, two valleys are seen, formed by two twin streams, one having an Easterly and the other a Southerly direction. The former has been made by the streamlet just mentioned, and leads to the sea direct,

whilst the other has been scooped out by a rivulet, having its source only a few inches distant, and which after passing through Deepdale falls into the river Derwent at Seamer Carr and eventually into the river Humber. The source of this stream for a short distance, about 1,400 feet, forms a portion of the Southern boundary; from the point however, where it ceases to be so, to the source of the Peasholm Beck, the boundary line has been determined in a different manner and is purely artificial, it passes from the point just named in a South Westerly direction over the Southern end of Weaponness Hill, and then across the valley in which the Railway and Seamer Road lie, skirting the latter for a short distance, and then ascending over Falsgrave Hill, along the foot of Seamer Moor to the road already named from East Ayton, and thence down into the valley, where the natural boundary of Peasholm Beck begins—a distance of about 2 miles and 144 yards—along the intervening limits of the borough, or about 300 yards less than a fifth of the whole circumference of the borough, which amounts to about 9 miles and 71 chains.

Those who desire to have a good idea of the inner protective circle, should walk along this land-ward boundary of Scarborough; and then judge for themselves how the physical features of the country on both sides must influence the climate of the town within.

The Parliamentary Boundary Line may, for convenience sake, be divided into six portions as follows:

1st.—*The Northern.*—This extends from the centre of *Peasholm Beck*, where it falls into the sea, along the *North Sands* to the North point of the *Castle Hill*; total length about 1693 yards.

2nd.—*The Eastern.*—From the last point around what are now the almost inaccessible but beautifully grand cliffs, which characterise the promontory of Castle Hill to the centre of the shore end of the Ramsdale Valley; total length 1 mile 190 yards.

3rd.—*The North Eastern.*—From the last point, around the *South Sands* to the centre of the beck, which we have seen arises at the foot of Knox Hill, and falls into the sea to the South of the White Nab; total length 1 mile 1296 yards.

4th.—*The Southern.*—This portion extends from the last point, which is the most South Eastern part of the borough, along the course of the beck just named to the point where the line crosses Seamer Road; total length 2 miles 81 yards.

5th.—*The South Western.*—This portion is nearly parallel to the *North Eastern*, and extends from the Seamer Road to a point in the bye road leading from *Stepney Hill* near *Row Farm* under Row Brow; total length 1 mile 1490 yards.

6th.—*The North Western.*—This portion extends from the East point along the course of the *Peasholm Beck*, to the one from which we started at its junction with the sea; total length 2 miles 340 yards.

The total length therefore of the Parliamentary boundary lines amounts to 9 miles 1571 yards, and embraces an area of 2292 acres, 1 rood and 35 poles, on which stood at the last Census, 1881, 6236 inhabited houses, containing 6554 families consisting of 13,543 males and 16,960 females, or a total number of 30,503 persons, or 4·6 individuals to each house; and 13·3 persons to an acre: the average in 1880 being in 20 large English towns, 37·4. London having a mean density of 50·0, Liverpool 105·1, and Brighton 45·2.

The Aspects of Scarborough can easily be mastered by studying the map; which for the purpose of clearly defining them, and at the same time giving the heights and *altitudes*, has been drawn with *contour lines*, giving the levels throughout the borough, from high-water mark for every rise of 25 feet above that datum. Each contour line has a figure attached to it, which represents the number of feet above the sea level. Take for instance the two contours representing the hundred feet levels, one of which commences on the *North*, and the other on the *South* of the Castle cliff. *The Northern Hundred-feet Contour line* for all practical purposes may be said to commence about 164 feet below the summit of the North point of the Castle Cliff, it then passes to the West under the North Cliff, above the Castle Holmes, but 185 feet below the site of the Castle Keep; from this point, the height above the line gradually lessens, up to the end of the passage leading to the cliff from *St. Mary's Church*, where the Russian cannon-

trophy stands, and where this contour line is about 102 feet below the edge of the precipice, in fact, the 200 feet contour line will be seen to terminate near this point. From this spot it passes along the North Cliffs underneath Mulgrave Terrace, the Albion Hotel, Rutland Terrace, and Blenheim Terrace, at about the following varying distances from their sites respectively, viz: 94, 63, 61 and 50 feet, or a mean distance below the roadway of 67 feet, which of course would give a mean height to the North Cliffs, from the gun passage to the end of Blenheim Terrace, of 167 feet. The line may then be traced, still considerably under the edge of the cliff, to the North West, crossing the road and tramways to the Promenade Pier, until after passing beneath the cliff, on which the Queen's Parade and Queen Hotel are built, it crosses the road along the edge of the cliff, within a short distance to the South East of that most healthily situated, well-conducted, and most comfortable Hotel, "The Alexandra;" from this point it takes a Southerly direction, and passes along, after crossing the *North Marine Road*, the South East side of the valley of the watercourse (which rises in the heights of the South of *Reston Street*), through the North West corner of the Borough Gaol (Cemetery Road), to the point South East of the Cemetery, here it crosses the bed of the watercourse, alluded to above, passes along its North East side until it reaches the Eastern bank of Peasholm Beck, it then turns sharply to the South West, passing up the ravine formed by Barrow Cliff (150 feet) and a little to the North of Chapman's Pasture meets the Parliamentary Boundary Line in the centre of the bed of the brook. *The Southern Hundred-feet Contour line* may be traced from just above the Battery on the Southern Cliff of Castle Hill, just above the Harbour, it crosses first the South Eastern end of the *Castle Dykes*, where it is 100 feet below the Barracks, to the West, across Castlegate and just in front of *Castle Crescent* (a depth of 130 feet below Castle Road), between *St. Mary's Walk* and *Long Westgate*, having Castle Road above it, varying in height from 130 to 70 feet. The line from this point passes over the South end of *Tollergate*, to the North of *High Westgate* to *Cross Street*, to the South through the *Wesleyan Chapel*, west end of *Market Street*, diagonally across *Queen Street* and *Newborough*, between *King Street*

and *St. Nicholas Street*, opposite the *Royal Hotel*, across *King's Cliff*, to the *Grand Hotel* and *St. Nicholas Cliff*, around which last it turns abruptly to the North West, reaching the Parade end of *New Road*, where it turns to the South West and defines the *North West* side of the *Ramsdale Valley*, passing to the South East of the *Belvoir Terrace* and *Crescent Gardens*, which lie between it and the 125 feet line. The line then passes to the North West of the *Fish Pond*, pursuing a course almost parallel to the *Valley Road* to *Westbourne Grove*, from the South side of which at about 400 feet distance, it forms an acute angle to follow its course along the South East side of the *Ramsdale Valley*, skirting *Grosvenor Road* and *Ramshill Road*, to the cliff, at which point *Belmont Road* is 50 feet above it. The line then takes a South Easterly direction between the edge of the South Cliff and the ordnance sea level datum, having the Esplanade Road 50 feet above it. Still further to the South East this line lies midway between the sea level and the summit of the cliff line, without much interruption until it reaches a very short way up the ravine,—which the beck has made for itself from Wheatcroft to the sea—in the neighbourhood of the Water Works Reservoir. From this point the line runs to the South Boundary Beck in the centre of which it meets the Southern Boundary line at 100 feet below the cliff that overlooks Carnelian Bay. We have thus traced these contour lines around the natural sea-ward boundary of Scarborough; for purposes of description they have been called *Northern* and *Southern*, although really part of one unbroken line, the connecting portion surrounding the Eastern Cliff of Castle Hill, from the Southern to the Northern points between 60 and 150 feet below the cliffs summit. These Eastern cliffs, which are not surpassed in grandeur by any others on this coast, are almost inaccessible to the visitor, and even geologists seldom approach them for the danger attendant on climbing them. This difficulty, it is to be hoped, will soon be overcome by the construction of a carriage drive and foot way from Peasholm Beck to Carnelian Bay, which when completed would form an unrivalled Esplanade, not only for residents but their visitors of all classes, who could not fail to be impressed with the lofty grandeur of the rocks above, and the grand sea below them.

Having myself rounded, almost on my hands and knees, this splendid headland, I was forcibly struck, during my perilous excursion, with the amount of capital that Scarborough was allowing to lie idle, in the form of magnificent immediate scenery, and healthful recreation to the thousands who visit it annually. With such a drive and such a walk, a visit to Scarborough would be an event not to be forgotten, but to be remembered and related to thousands, who, thenceforth, would long, in the search of health, to realize its calm sylvan beauties, and its gloriously wild cliff and sea scenery.

From the hundred feet contour line which, as we have just seen, is almost the natural boundary line between the town and the cliffs that elevate it above the North Sea, we must ascend to the 200 feet contour, which we shall find in the sequel has a superficial importance in the physical geography of this health-resort; for on the one hand, whilst the 100 feet contour line is the limiting boundary *in front*, separating the town from the sea below, the 200 feet contour line will be found to be the limiting boundary *behind*, separating the town from the inland heights which flank and protect it whilst deflecting its winds.

The Two Hundred feet Contour Line may be traced for convenience sake, from the point when the Southern portion of the 100 feet contour line terminates, or more correctly from the centre of the bed of the Southern boundary beck at a level of the 100 feet above that point. Between this line and the lower level of the 100 feet contour line the map is unshaded in order to obviate any obscurity in the legibility of the names of the streets, public buildings, etc.

Commencing then from the extreme South East of the borough boundary, we find the line taking a North Easterly direction to the heights above "White Nab;" and then around this point in a North Westerly direction along the edge of the cliffs, until it ascends to the South West up the valley of the beck, which has its origin near Wheatcroft; it then pursues a North Easterly direction again to the cliffs over-hanging the sea, and turning gradually to the North West pursues its course to the North West along the summit of the rocks, which form the background of the South Sands; at South Cliff the line turns inward to the West and continues

to the North foot of Oliver's Mount, around which to the South West it turns and forms the lower boundary line of this height as far as the Southern limits of the borough. The line just described encloses the *Southern Heights* of the inner protecting circle.

Crossing the valley, which has an average level at this point of between 125 and 150 feet, we ascend over the Seamer Road to the foot of the height called Falsgrave Moor, when we find the 200 feet level or contour line again, near the South Eastern extremity of the South Western boundary. From this point the line defines the base of Falsgrave Moor, Falsgrave Wood, and the heights to the extreme West of the borough, the heights form the South Western portion of the inner protective circle, between these heights and the centre of the town are found other elevated masses, such as *Spring Hill*, and those rising to the West of North Street and Wrea Lane, Falsgrave. These heights form the South Western and Western portions of the inner protective circle. At the North Eastern corner of the borough, we find this 200 feet contour line surrounding one of the most important factors in the climate of Scarborough—the Castle Cliff.

Commencing at Cannon Passage in the North Cliff it diverges to the North East and after passing entirely around this headland returns to the point whence it started. This height, with its towering Keep, forms the North Eastern portion of the inner protecting circle of Scarborough, which I shall describe in the next section.

The Aspects and *Altitudes* within the Parliamentary limits will be again given further on, in connection with the winds and other elements of Climate.

Aspects.—To the North of the ridge extending from the gates of the latter, along the sites of Mulgrave, Rutland, and Blenheim Terraces, the aspect towards the sea is Northerly, and further on in front of Queen's Parade North Easterly.

To the South of this ridge, lies, at a considerable altitude, the older part of the town, which has a Southerly aspect throughout.

The whole of the *South Cliff* has a North Easterly aspect seaward, but this part of the town is not only protected from the winds from this quarter by the superior height of the

Castle Cliff, but the precipitous character of the cliffs on which it stands modifies their force in the manner described in the introduction, and which will again be referred to further on. The heights to the South and South West present every variety of aspect, which will be more particularly noticed when the inner protective circle is discussed.

The Altitudes within the borough, although not great, are in consequence of their proximity to the central portion of the town, of eminent service as climatic agents. *Castle Hill* to the *North East* rises 285 feet at the base of the Keep. Oliver's Mount with its long ridge, culminates at 500 feet, and slopes very gently to the South, so that its protective power is great on all sides, considering that it stretches its crown of 450 feet from the South to the North more than 4300 feet, or considerably more than three quarters of a mile. The South Westerly heights range from between 300 and 400 feet at Falsgrave Moor to 250 at the extreme Northern end of the ridge, which however is continued on to Barrow Cliff (150 feet), on the East side of Peasholm Beck.

The Valley System is plainly defined by the shading from the 100 feet contour line to the ordnance datum. Within the borough there is:

1st.—Half the valley of Peasholm Beck, which forms the North Western Parliamentary boundary line.

2nd.—There is the water-course arising in the Falsgrave heights, and after passing under the Cemetery Road falls into the Peasholm Beck before it reaches the sea as before described.

3rd.—At the point where *Friars Entry* meets *Cross Street* there is a depression, which may be traced in an Easterly and Westerly direction, indicating the existence of a primeval water-course, which within historic times has been used as a mill stream, as surrounding local names attest.

4th.—There is the *Ramsdale Valley*, which has been scooped out by the waters supplied by the springs of the Southern heights, such as Weaponness, and Falsgrave Moor, after joining the Mere.

5th.—The valley of the beck, which has its source near High Wheatcroft, and

6th.—The half valley of the Southern boundary beck, which has already been referred to.

Before leaving this part of the subject it may be not out of place to refer to a disastrous circumstance which occurred on the evening of the 6th of August, 1857, inasmuch as it raked up the history of an old water-course, the former route of which was preserved up to a recent date in the names of thoroughfares, where "dams" formerly existed to bay back water for mill purposes. On the date named there fell in Scarborough an unprecedented rain-storm, which although of short duration, seems to have poured down upon the town in the form of a waterspout, concentrating itself on the elevated ridge, where Albemarle Crescent now stands, and which is indicated on the map by a broad heart shaped isolated contour line marked as a level of 175 feet. At the time this area consisted of fields, near which was a pond; this soon overflowed and the water rushed in torrents into Aberdeen Walk, across which it made its way and then underneath the archway on the North Eastern side of this street, whence it flowed like a river to North Street along Lotts' and Coulson's yards (now Atlas yard), through the Old Brewery yard into the "old water-course," choked up the Gullies in Queen Street near Mrs. Milson's Castle Hotel, thence under the archway, knocked a garden wall down on the premises, drowning and washing away a number of her pigs; after this it pursued its destructive course to Cross Street, where it filled up the hollow there, afterwards forcing its way into the Friarage, knocked more walls down near the Quaker's Meeting House, filled up the hollow in St. Sepulchre Street (where the sewer burst), and finally made its way to the sea. Such was the course of this destructive torrent, which within a few minutes, on a summer's night, was the cause of wide spread dismay, and an immense loss of property. It is probable that the old water-course, over the site of which this sudden flood rushed with the impetuosity of a torrent, had a similar source, to the one which can still be traced from the heights to the North of North Street, Falsgrave, and which follows the course of Gladstone Road to the West of the borough Gaol, where it crosses underneath the Cemetery Road, and finally empties itself into the Peasholm beck, to the South of Scalby Road as it passes the borough boundary.

From the North end of Oliver's Mount, which is 500 feet high, the whole of Scarborough lies before the spectator, and from this point, with the map in hand, the physical geography of the town can well be studied, and the protective influence of the different heights well seen. On the West the valley of the Mere is seen, which is the higher portion of the beautiful Ramsdale, leading to the sea, amidst a well-wooded ravine, traversed by a carriage drive, and intersected on both sides by walks, which in the summer afford a delightful protection from the sun, and at all times a recreation amidst beautiful scenery of land and sea. This valley of the Mere is also a continuation of the one which leads into the Vale of Pickering on the South, and possesses great natural beauties, which could not only be enhanced by drainage, and cultivation, but by the planting of appropriate trees, be made still more beautiful than it is; besides which, the drainage, the cultivation, and the planting of trees, would heighten the mean annual temperature of the valley, and as the winds from the South are deflected up it, this increased temperature, and modified climate would have a considerable effect upon that of the town generally. If the map be examined there will be found on the Western side of Oliver's Mount a point where the whole of the contour lines, from those which skirt the Mere, to those which crown the brow, present curves, the convexity of which point to the East. This point I have visited over and over again, during all weathers, and I am convinced that there is no spot in England where so good a site could be found for a Consumption Hospital, provided what I have said about the Mere Valley be carried out. I have already advocated the planting of trees of the pine tribe on the North Cliff and other parts of Scarborough; but in no place would a pine grove be so appropriate as the West side of Oliver's Mount. The healing influence of the emanations from all parts of the trees of the pine tribe are now too well known to be enlarged upon here, although further on I may mention some facts which I think proper to dwell upon in support of my views on this subject. Flanked as the Mere Valley is, not only by the heights of Falsgrave Moor and Wood, but by the large masses of Seamer Moor and Oliver's Mount; the one with its 600 feet of altitude protect-

ing it from the full force of the prevailing Westerly winds, while the other of almost equal height (500 feet) excluding from it the influence of the East wind; it only wants the help I have indicated to make the site I have pointed out one of the most perfect of its kind. If those who doubt it will stand on the spot I have attempted to describe, at a height of about 200 feet, they will soon realize what I have said.

The other great protecting height within the borough boundaries is the *Castle Cliff*, with its altitude of 285 feet; the influence that this headland has upon the interior must be evident to all who either examine the map, or study the panorama before them whilst standing on Oliver's Mount. These precipitous cliffs facing, as they do, the East, the North East, and the South East, and standing, as they do, above so great a portion of the town, cannot fail to have a most beneficial influence on the climate of Scarborough. Whilst standing on this elevated platform, or the reader does so in imagination, I will proceed with the concluding part of this section.

The Position of Scarborough with regard to other Localities.—The *Wind Chart* on the map, not only shows the mean direction of the winds during 1877-81, at Scarborough, but the names of the surrounding seas and lands, over which they may blow before reaching it. It must be remembered, that from whatever point of the compass the winds blow, their character, as *sea winds*, is in the direct proportion to the amount of sea area, over which they travel from the continent. It must not be forgotten also that the more the winds are in contact with the sea, the more do they participate in its climate, one of the chief elements of which is, its small range of daily, seasonal, and annual temperatures; and lastly that the insular character of a climate is in the direct proportion to the smallness of this range. These facts are not sufficiently recognised in estimating the suitability of a climate to meet certain health requirements; but knowing from experience how much depends upon the surroundings of a Health Resort, I have made such additions to the "Wind Chart for the Year" as I have thought necessary to indicate those of Scarborough. A summary of these surroundings will now be briefly given.

From the North by West to the North North East, no land intervenes as far as the Arctic Ocean, although the Gulf Stream, in its passage to the North West coast of Norway, exercises its influence on the winds coming from these points. This remarkable warm water current from the Gulf of Mexico, has a mean annual temperature at the Faroe Isles, 62° Lat. N. of 43° Fahr.; at Shetland 60″ 61° Lat. N. of 45° F.; and at the Orkneys 59° Lat. N. of 46° F. From the North East by North to the North East lies Norway, with the Naze, the nearest point, at a distance of three hundred and eighty five miles across the North Sea. In a direction North-East by East, through the Skäger Rack to the coast of Görtenberg, Sweden, there is a stretch of 520 miles. From East North East to East by North Denmark lies, and this narrow peninsular is all that separates the North from the Baltic Sea. Due East at a distance of 370 miles lies Schleswig Holstein. In a South Easterly direction Scarborough is 250 miles from the continental coast of the Netherlands and Belgium. From the South East to the South West by South, the spectator looks towards the East Riding, the Yorkshire and Lincolnshire wolds, the Eastern counties of England, the English Channel and France. At the South West by South point, the greatest breadth of land lies between Scarborough and the Land's End, which looks towards thousands of square miles of sea. The South West winds in their passage to the North East do not cross the highest parts of the backbone of England, but rather follow the valleys of the Avon and Trent rivers. From South West by West to West by North Ireland intervenes between the Atlantic and Irish Sea and St. George's Channel; whilst the lofty mountains of Wales, and the high lands of Derbyshire, and the South of the West Riding materially influence the temperature and the rainfall of the winds, which pass over them before they reach the vales of York and Pickering.

From the West by North to North West by West, there is the opening to the Atlantic through the North Channel the large expanse of the Irish Sea, which at Morecambe Bay is separated from the North Sea by about 95 geographical miles only; a fact of great importance, to which I have already drawn attention in my papers on "English Sea-side Health

Resorts." The proximity of the two seas gives a peninsular character to this interlatitudinal zone, which goes far to neutralize the effect of latitude. Between the above points, Cumberland and the West Riding intervene, and their physical characteristics materially affect the rainfall on the Scarborough coast. Between North West by West and North by West lie Scotland, Northumberland, and the North Riding; of the immediate effects of this part of Yorkshire on the climate we are discussing I shall treat in the next section. We have thus seen that Scarborough from its position has a wider expanse of sea on all sides than is possessed by any other Sea-side Health Resort on the English coast; that this breadth of ocean to which it is exposed endows its climate with a peninsular character, as evidenced in the small range of temperature it enjoys throughout the year, the facts connected with which subject will be found in section VI., and in the diagram representing the temperatures of the air and sea on the map.

SECTION III.

THE PHYSICAL GEOGRAPHY OF SCARBOROUGH CONTINUED; ITS INNER AND OUTER PROTECTIVE BOUNDARIES, AND THEIR EFFECTS ON THE TEMPERATURE; THE WINDS AND THE RAINFALL.

SCARBOROUGH with all the advantages of a seaward boundary and precipitous cliffs could never have enjoyed the climate it possesses, nor its reputation for being hostile to consumption and other diseases, had it not been protected *landward*, on three of its five sides, by heights which screen it from the most powerful winds that sweep over the British Isles, and yield during the colder months of the year their stored up summer heat.

Had Scarborough been built upon an elevated platform between one and two-hundred feet above the precipitous cliff

line as it is, without having the protective boundaries which it enjoys, it never would have contained 30,000 inhabitants, neither would it have achieved the high rank it takes amongst first-class health resorts.

The basis on which this reputation is founded is a natural one, and therefore one that cannot be undermined by detraction so long as those who have the management of its Sanitary regulations do their utmost to make the best of the advantages which nature has bestowed upon their town.

The geographical position, and the physical character of the surroundings of Scarborough, all of which unite in forming its climate, make this town an exception to the whole of the health resorts on the East of England, and superior to most on the Southern and Western coasts.

I will now endeavour to describe what the natural surroundings of Scarborough are, and for this purpose will divide them into inner and outer protective boundaries. The physical character of every locality is so dependent upon its geological formation, that I must refer the reader to the section on the geology of Scarborough for an explanation of some of the more remarkable features within the parliamentary boundary.

The Inner Protective Boundary.—If we take the several heights along the *Southern boundary* (p. 20), we shall find a *mean* altitude of nearly 300 feet (294 feet), but if this line be divided into an Eastern and Western portion, then the Western, owing to its crossing over the Southern end of Oliver's Mount, will be seen to present a more effective barrier to Southerly winds, except where the valley of the Mere separates the Southern and South Western boundaries. Thus the portion, East of the road leading from *Low Wheatcroft*, has a mean altitude of 213 feet, whilst that to the West attains 375 feet mean 294 feet; the *Mere Valley* at this point lying between the two 125 feet contour lines; Oliver's Mount however not only raises the mean altitude at the boundary line, but stretches far into the borough in a Northerly direction, and exercises a most important influence not only on the town but upon the climate of the Mere Valley, which in its turn imparts its characteristics to every current of air that travels along this inlet towards the town; a fact that shows the great

importance of not neglecting either the drainage or the planting of this most beautiful and natural physical characteristic. Again, Oliver's Mount is an elevated mass of land, that not only shelters, but stores up heat in the summer and gives it out on all sides in the winter; moreover, at a certain distance from its surface, namely 25 ft., at which point, the temperature ceases to fluctuate according to the seasons, it contains a vast core of rock, permeated by springs, having the mean annual temperature of Scarborough, which will be shown in the sequel to amount to 47° 6 Fahr. according to the observation made at this station during the 14 years 1868-1881 inclusive. The effect of this storage of heat is two-fold: *First*, its radiation into the atmosphere during the winter heightens its temperature, and the winds that blow over this mass of elevated rock carry it to the town, when in that direction, and thus the rigour, which they had acquired whilst passing over the less *insular* and therefore the more *continental* parts of England, is ameliorated: *Second*, this *heat store* is brought to the surface and carried along the valley by the *springs* which issue from many points along the sides of this reservoir of mean and seasonal temperatures; in the first place the more shallow springs carry out with them the varying temperatures of the crust which envelopes the core; and as it has been shown by experiment on other elevated masses, that it takes nearly six months for the summer heat and the winter cold to penetrate to the lowest depths of this crust, it follows that during the winter months, the springs issuing from these depths are in winter *warm*, or considerably above the temperature of the air, and in summer *cold*, or many degrees below it. In the second place the deeper springs, which have their hidden sources far in the centre of the core, give out perennially the mean annual temperature of the locality, which in this instance is 47° 6 and therefore nearly 10° 0 Fahr. 9° 6 higher than that of the coldest month January, which during the same 14 years is proved to be 38° 0.

Placed, as Oliver's Mount is, within the borough as nearly North and South as possible, we can easily understand how on all sides it receives the sun's rays; from sunrise to noon the Eastern side and summit are fully exposed to them, and from noon to sunset the summit and Western side receive them. It would indeed be interesting and most important to

test the temperature of the springs as they issue from this bold escarpment, and compare them with that of the surrounding air during the different seasons; and since the causes of the special climate of Scarborough should be well studied, there is every reason why such experiments should be made, and at once, as by doing so in years to come, the present results would then be at hand for future comparison, when the draining, the planting of trees, and the enlarging and deepening the Mere, have had time to effect a change.

The South Western Boundary—(p. 20)—consists of a part of Seamer Moor, Falsgrave Moor and Wood, and Stepney Hill, and has a mean elevation of about 446 feet, but as it is flanked immediately by the more elevated portions of Irton and Seamer Moors, its effects on the climate of Scarborough are subordinate to the more elevated mass to its South West. It will, however, be seen how thoroughly these heights must break the force of the South Westerly *anti-trade* winds, and how, when of moderate strength, deflect them, and thus account for the exceptional direction and prevalence of certain air currents, as indicated by the wind charts.

The North Western Boundary—(p. 20)—has a mean altitude of only about 221 feet, the higher portion lying immediately to the West, but to the South of a line drawn from the Grand Hotel to the boundary, it slopes more or less uniformly to the North Eastern side of Peasholm Beck, and affords the least protection immediately, of any of the inner protective boundaries. This low range of heights admits freely, not only the general winds from the West, but the deflected currents from other points, as will be seen when the wind charts are presently described, and the prevalence of certain local winds accounted for.

In the next section, which will contain a sketch of the geology of Scarborough and its immediate neighbourhood, as far as it is required for an explanation of the physical geography, these heights will be again referred to, moreover, they will be found in the list of heights belonging to other protective boundaries; in which list will be given the names of these heights, their distance from the centre of the town, and their geological character, for easy reference. *The Outer*

Protective Boundary, which exercises such a powerful influence on the climate of Scarborough, must now engage our attention.

The real Outer Protective Boundary has a very definite form, and winds round the area, over which all the land winds that reach Scarborough must blow, in the shape of an irregular amphitheatre. It consists: I. Of "The Eastern Moorlands," a series of oolitic hills stretching from Bay Ness (to the North of Robin Hood's Bay), through Black Hoe, Burton Head (1489 feet), to the heights above Brompton (1138 feet). II. From Brompton to Malton the hills take a South Easterly direction, and are divided by the Hole Beck with a Northern and a Southern range: the former are called the *Hambleton Hills*, and the latter the *Howardian Hills*. Through these hills the river Derwent has cut the only opening into the central valley of the amphitheatre that is to be found from Bay Ness round to Flamborough Head. And, III. The *Yorkshire Wolds*, the well-known chalk range of hills, continue to form the Southern boundary of the quondam lake basin, now called Ryedale, and the Vale of Pickering. Thus it will be seen that these several ranges are continuous, except where the Derwent has cut a gorge through their extreme South Western heights near Malton, and form a protective boundary of a somewhat horse shoe shape, the base of which extends from Bay Ness to Flamborough Head. The ridge, which has just been followed, has a circuit of more than ninety six miles, and presents a barrier to all the *land* winds of Scarborough, from the North by West, round by the West and South to the South East by East point of the compass. The lake which the drainage of this ridge formed was of sufficient area to contain the whole of the Cumberland lakes now in existence, and its influence on the climate of this district must have tended greatly to raise the mean annual, and the mean daily range of temperature.

The lesser Outer Protective Boundary, the details of which will be found in the list of heights that surround the sources of the river Derwent, extends from *Old Peak*, through Stoney Marl Howes, Pie Rigg Howe, Low Moor, Fylingdale Moor, Burn Howe, and Lilla Cross Rigg, Derwent Head Rigg, Allerston High Moor, Lockton High Moor, Saltersgate Moor,

Lockton Low Moor, Allerston Low Moor, High and Low Dalby Moor, Brompton Moor, Hutton Bushel Moor (Shortgate Wood Heights), Scarwell Wood heights, the Forge Valley Heights and Seamer Moor, to the point in the South Western boundary of Scarborough which gives rise to Peasholm Beck. The Southern heights of the Yorkshire Wolds have already been included in the greater protective boundary. The above heights embrace the many sources of the Derwent and have a mean altitude as follows: From the point North by West to North West, i.e. from *Old Peak* to Fylingdale Moor, the boundary has a mean level above the sea of 766 feet, the highest being that above Old Peak, 872 feet, and the lowest that part of Fylingdale Moor, which has within this portion 684 feet. From the *North West* to the *West* the mean altitude is 851 feet. The highest point being Burn Howe Rigg, 978 feet, and lowest Lilla Cross Howe and Rigg, 769 feet. From the *West* to the *South West* the mean altitude is 587 feet; the highest being Brompton Moor, 695 ft., and the lowest Scarwell Heights, 400 feet. The mean distances from the centre of Scarborough being for these three divisions respectively, 9·8, 10·6, and 5·9 miles. A little careful consideration of these heights, and a perusal of the list of elevated masses which I have appended,* will aid the reader in understanding the effect of this large area of elevated land on Scarborough; for what has been said of Oliver's Mount, which stands in the midst of the Borough, is equally applicable to all the heights I have named above and given further on. There is, however, yet another remarkable mass of elevated ground, lying amidst the moors just named, and isolated from all around, in the strictest sense of the term, for the network of streams which surround it on all sides do not enter it,—it is to all intents and purposes *an island*. It has its own separate watershed, and is independent of all sources of water, except the rain and those found within its own remarkable area. The Derwent flows along its western and south-western heights, the "New Cut" crosses its southern point under Hawthorn Wood, from the Derwent to Scalby Beck, on the North East and the East; it then unites the Lawthorn to Lindhead Beck, which flows into Scalby Beck just below the entrance of the New Cut. This island from

* See Section on the Geology of Scarborough.

its extreme North West to its South East is about 4½ miles in length, and nearly 3 miles in breadth, so that it contains about 12 square miles; and the distance of its centre from that of Scarborough is about 5 miles. The mean altitude of this island is 568 feet above the sea level, and it lies between North West and West of the centre of the town. The *Heights* consist of Hackness Moor, 600 feet, Silpho, 650 feet, Suffield Moor, 633 feet, Suffield Heights, 500 feet, Hawthorne Wood, 525 feet, and Scalby Nabs, 500 feet. Its principal stream is Lowdales Beck, which, after collecting the waters of the Highdales beck, Whisperdales Beck, and Breaday Gill, empties itself into the river Derwent, to the South of Hackness, at the point where it flows around Coombe Hill and Wrench Green. The chief characterestics, however, of this beautiful inland island are its wooded dales, and I need only name a few to recall to Scarborough people and their visitors, the healthful beauty of those sylvan valleys; had it not been for its woods and plantations I should not have entered into the details I have with regard to this favoured spot. What has been done here can be done in Scarborough, wherever a hill side or a cliff side presents a soil into which a tree can spread its roots. Plantations can convert a continental into an insular climate, and enhance the amenities of the most insular. Following the beautiful streams of this island, we have around us, from the North West to the South East, plantations and woods following each other in close succession —thus we have the Suffield Moor Plantation, the Breaday Heights Wood, the Swinesgill Plantation, the Oak-Rigg Wood, the Ash Hagg Plantation, the Springwood Heights Plantation, the Broxa Moor Plantation, the Hilda Wood, the Bellheads Wood, the Hackness Head Wood, and a host of others too numerous to name, all combining to render this area one of the most charming resorts for the health seeker and the lover of scenery, whilst they ameliorate the climate of their vicinity, and soften the rigour of the atmosphere which pours over them to Scarborough.

I will now endeavour to show how these natural elevated physical boundaries affect the temperature, the winds, and the rainfall at Scarborough. In the first place, I will add a few words regarding temperature as affected by elevated masses, in

addition to what I have already said when speaking of Oliver's Mount. What I then said of the storing of the summer heat, and its restoration to the atmosphere during winter by means of radiation and springs, both superficial and deep, that issue from its sides, is applicable to every height that has been named, and in a lower degree to the hundreds of others which the list does not contain. If, then, we reflect on what the sum of all these influences would be, or rather really is, we shall be able to conceive some idea of the effect of this elevated area, at the foot of which Scarborough lies, on the climate of that health resort.

These heights, however, from the outer to the inner, force the rain-bearing winds up their sides, and thus cause condensation and precipitation of the watery vapours they contain, now it is shown in the well known and valuable rain chart of Mr. G. J. Symons, F.R.S., that a greater amount of rain falls annually on the outer elevated boundary than at Scarborough; the effect of which would be to reduce the amount of moisture in the air current at the point of precipitation, and secondly, to increase the temperature of the current; for it is a well known fact that water in a state of vapour requires a large amount of heat to maintain this condition, and that it parts with the greater portion of it during condensation into the liquid form. This surplus heat, which was *latent* in the vapour, becomes *sensible* in the atmosphere, and is carried by the wind over the lower lands to the lee-ward. For this reason it is often said: "it will be warmer when the rain has fallen;" and this phenomenon is even more noticeable after a fall of snow, for the same reason. On the other hand, the conversion of water into vapour reduces the surrounding temperature, by abstracting heat from the atmosphere, hence it is that over undrained land, the evaporation that is constantly taking place reduces the temperature of the atmosphere by abstracting from it the necessary amount of heat to convert water into vapour. On the other hand, by draining land we render the soil drier, diminish the amount of evaporation, and negatively increase the temperature of the area by preventing the abstraction of heat from the soil and the atmosphere above it. For this reason the planting of trees is so important, for they not only diminish the amount of evaporation from the ground they

cover, but interfere with the radiation of heat into space, especially on cloudless nights. The planting, therefore, of trees on hill slopes renders the valleys warmer and prevents frosts; moreover trees offer resistance to the down-flow of cold air from the summits of heights that are bare and treeless. After these remarks I need hardly dwell on the effects of the woods and plantations which I have just enumerated as clothing the valley sides of the inland island, to which I have just drawn attention.

The wind charts for Scarborough show a peculiarity I have rarely noticed in the many others I have constructed. As a rule, throughout the British Isles, the prevalent winds do not come from the four cardinal points, viz.: North, East, South, and West, but rather from the intermediate ones, as South West, North West, North East and South East. In the case of the winds of Scarborough, an exception to this rule is obtained, and I believe that it is caused entirely by the form and position of the surrounding heights; this I shall again refer to when treating on the winds, but I may here call attention to the marked prevalence of the West wind, which during the five years, 1877-81, blew 103·2 days on an average, whilst the South West occurred only on 44·4

A glance at the one inch ordnance map of Scarborough and its neighbourhood, will explain how this happens; the winds from other points get deflected, and find at the north of Seamer Moor a trough, which readily guides them over the less elevated part of the North Western boundary of the borough.

SECTION IV.

The Geology of Scarborough and its Neighbourhood.

THE geological character of the neighbourhood of Scarborough, and of the site of the town itself, having had such a powerful influence in their physical conformation, and exercising so great a power over their present climates, a brief

general description of their geology is necessitated in order to link the two subjects together.

Brief, and as devoid as possible of technical detail, must be my description, for I simply desire to give the reader a general idea of the present face of the country, and how its characteristic features record their own natural history.

If we take the "fair water" river Derwent as our guide and trace it from the point near New Malton, where it leaves Rye Dale through the gorge that it has carved for itself across the Oolitic Howardian Hills, to its sources in the Eastern Moorlands, we shall have successively before us, all the important geological formations from the most recent flood deposit to one of the lowest of the Lower Oolite Series, viz.: *The Scarborough or Grey Limestone Series*, or Pier stone, from the fact of its having been used in the construction of the Harbour Pier. This limestone is well seen on the North side of *White Nab;* the bay-like quarry, and the wheel worn tracks are records of the uses to which it has been applied. In front of the Grand Hotel at *low* tide can be seen *Ramsdale Scar*, which is composed, at the North end, of *this Scarborough Grey limestone;* if we now go to *Pie Rigg Howe* and look towards *Stoney Marl Howe*, a distance from Scarborough about nine miles, and 800 feet *above* the level of the sea, we shall see a few feet below us one of the sources of the Derwent, running through a channel which it has cut for itself into this same rock, tilted up however more than 700 feet above the Ramsdale Scar. This tilting up of the Strata, which form the frame work of the hills and dales, accounts for the origin of the lesser outer protective boundary; the dip in a South Easterly Easterly direction of the different beds of limestone, sandstone and clay; and the *South Easterly* and *Easterly* courses of the many sources of the Derwent.

The Sandstones and shales, that form the cliffs above the South and North Sands, are the seaward end of the platform, which, whilst resting on the bed of Scarborough, or Grey Limestone, stretches in a North Westerly direction to the watershed which separates the sources of the Derwent from those of the Esk, and supports all the elevated masses of land with which this beautiful area is diversified. These *Sandstones* and *Shales* are at the present date known as the Upper

Estuarine series of the Lower Oolite, and the cliffs are interesting to the visitor, because they form the geological basis of the town itself, glacial drift intervening; they afford good specimens of what is technically known as *false bedding*, and in their lower portion are to be found bands of granular ironstone nodules, seams of coal, and the fossil plants, which formed them. The continuity of this sandstone platform is unbroken, except where the rivulets have worn their way through it at the point mentioned, and some few others on the Eastern and North Eastern portion of this area, where the *moor grit* is exposed lying above the Scarborough limestone.

On this extensive and sloping platform rest all the distinct elevated masses of land, which I have enumerated and described as lying North of the vale of Pickering. These masses are composed of the higher and therefore more recent members of the Oolitic formations; in fact all those beds above the sandstone platform, which have escaped in the first instance submarine denudation, and since their elevation above the sea those destructive atmospheric agents: frost, rain, and carbonic acid: the *first* splitting up and crumbling the hardest stratified rocks; the *second* washing the debris away from the hill side, and carrying it along innumerable rivulets, swollen into torrents after heavy rains, into the lower lands, there to fill up hollows like the vale of Pickering; and the *third* sinking with the rain, in which it is dissolved, into the strata below, dissolving the limestones it meets with, tunnelling out passages between the rifted blocks, supplying springs, and eventually carrying to the sea an enormous mass of dissolved carbonate of lime. These agents, we must remember, acted in all probability with greater force than they are seen now to do, when the rigour of the climate covered the heights with snow, filled the water-courses with glaciers, and during thaws rendered the becks and rivers more torrential and destructive than they are at the present time.

To obtain a correct idea of what formations really lie upon this sandstone platform, I will give in their order the names of the different beds of the Oolites and the Chalk series, which lie above them; proceeding from the North across the vale of Pickering to the South.

1st.—The geologically *lowest* bed is the *Scarborough Lime-*

stone, the *Pier Stone*, the Grey Limestone series; this forms the "*Black Rock*" to the North of White Nab, crops out at Ramsdale Scar, at Cloughton, along the course of Jugger Howe Beck and its sources, and elsewhere to the North and North East of this area: it makes excellent building stone, and the false bedding adds to its beauty after dressing.

2nd.—The platform of sandstones and shales; the *Upper Estuarine series* lie exposed, except where covered by glacial drift along the North and South cliffs, to the highest points of the Derwent basin, viz.: Derwent Head and Burn Howe Rigg, 952 ft. and 978 ft. above the sea level respectively. The detached elevated lands lie to the South West of this extensive tract of moorland.

3rd.—Immediately on this platform lies the *Cornbrash*, a thin limestone bed seldom if at all found in separate outlier *without* being protected by a capping of Kellaway rock, and some other of the higher series. Throughout England it preserves an almost uniform thickness of about 14 feet; and would soon become, if exposed, an easy prey to the solvent powers of carbonic acid, being a limestone. Its points are well preserved and just below Blenheim Terrace, on the North Cliff, this bed crops out and still affords an abundant and interesting supply of fossils

Immediately above the *Cornbrash* lie the following beds;

4th.—Kellaways Rock consisting of sandstones and shale bands:

5th.—Above which rests the *Oxford Clay* and the superincumbent

6th.—Lower Calcareous Grit, with its massive sandstones passing into sandy shale, above the Lower Calcareous Grit lie

7th.—What are called "Passage Beds," above which are

8th.—The lower Limestone, Oolitic Limestone with Coral Rag at the base, then

9th.—Impure Limestone and sandstone called Middle Calcareous Grit, on which lie the

10th.—Coral Rag and Oolite Limestone (Upper Limestone) and surmounting all

11th.—A sandstone called Upper Calcareous Grit.

So far then as what are called the Lower and Middle Oolites are concerned in this area, the list ends with the *Upper Calcareous Grit:* but there are the Upper Oolites, consisting of Kimmeridge Clay and the Portland Beds to be accounted for, as well as the Chalk series lying above them; now it is very evident that these enormously thick deposits were once in place close to the Northern district, occupied by the middle and lower Oolites, for we find along the Northern boundary of the vale of Pickering in consequence of a *fault*, the villages of *Wilton, Allerston, Ebberston* and *Snainton*, on the West side of the Derwent, and Cayton, Lebberston, Gristhorpe and Filey on the East side of this river lying on the Kimmeridge Clay. It is interesting and instructive to follow the sequence of geological events at this point, where the last hard beds of calcareous grit of the middle Oolite, stretch out to sea, defying the action of the waves in the form of Filey Brigg, and are immediately succeeded on the South by the soft Kimmeridge Clay of the Upper Oolite, and the Speeton Clay (Neocomian), which underlie the Red Chalk and the other chalk beds that form "The Wolds."

The vales of Pickering and Ryedale were once an arm of the sea, formed by the destruction of the upper part of the Kimmeridge Clay, and the gault like clays above them, now called the Neocomian Clays of the lower Cretaceous: remains of ancient beaches, when the North Sea had free access to this estuary of the Derwent, are still traceable on the North and South sides: on the South the old raised beech consists of sand (west of Flotmanby) and angular and partially rounded fragments of chalk and chalk flints; these sands are from 30 to 40 feet thick. On the North side the sands and shingle composed of water-worn pebbles of Oolitic rocks of the neighbourhood, are finely stratified, contain shell fragments, and form a well marked Terrace—as described by Mr. Strangways— at Wykeham, Hutton Bushel, and Ayton. These sands and gravels occur also at some little distance above the level of the watershed near Filey, and exactly opposite to what would have been the entrance to this valley, when it was an arm of the sea. During the glacial period submergence of this land took place, glacial drift was deposi-

ted, and when re-elevation occurred, the entrance to the inland sea was barred by drift and silt, and the former sea gulf converted into an inland fresh water lake, receiving the waters of the Derwent and collecting in its basin the waste from the high lands. Whilst, however, this valley was still a gulf, it received the Alluvium from the rivers, and thus it is that we see Lacustrine Clay and warp of different ages. They are in this district chiefly exposed at the surface in the great flats south of the villages of Wilton, Allerston, Ebberston, and Snainton; in fact lying on the Kimeridge clay of this district. Peat is found extensively in this valley along the line, according to Mr. Strangways, of the dike called the New Hertford River between Willerby and Muston. These patches are called "Sulphur lands." Such local names as "Bog Hall" and "Black Dike" give a clue to the nature of the deposit.

These are all the principal geological formations to be found within the area that immediately affects the climate of Scarborough, and some knowledge of the above facts is necessary to the Medical man, and may prove interesting to the visitor, who now will have some idea of the country he passes through by rail from New Malton to Scarborough, and thence to Derwent Head, by road and track.

Journey by railway from New Malton through Pickering vale to Scarborough.—At New Malton Station the river Derwent is seen on the North West side of the line, between which and the town it flows out of the vale, Nortown being on the South East: in fact from Kirkham station to the South West through Castle Howard station to New Malton, the line passes through the gorge in the Oolitic Howardian Hills, which it has made for itself. After New Malton we pass at once into the vale of Pickering, skirting the old beach of sands and gravels consisting of flint and chalk pebbles above described, on the South through the whole journey the chalk wolds are seen, and on the North are the Oolitic Hills, above Wilton, Allerston, Ebberston, Snainton, Brompton, Wykeham, Hutton Bushel, East and West Ayton, Irton, and Seamer, all of which except the first four lie on the Northern old beach of the ancient estuary, consisting of sands and pebbles from the Oolitic Hills, which once formed the sea boundary. If the visitor gets out at West Heslerton station

and walks towards the village, he will then realise this ancient beach, the sands of which are still blown through every opening in the roadside hedges forming sand heaps, just in the same manner as drifting snow does opposite the gaps through which it is blown. Throughout the route we are passing over lake deposits of sand, gravel, clay, and peat, varying in depth and position; thus at West Heslerton station there are 35 ft. of sand and gravel, lying on twelve feet of fine clay, resting on 2 ft. of *white* gravel with water, beneath which is a hard *black* clay: at the Sherburn and Weaverthorpe station we reach the neighbourhood of *Peat*, for at this point there are 5 ft. of this formation lying upon 36 ft. of sand and gravel, having beneath it 34 ft. of fine *white* clay with seams of sand on a bed of *white* gravel with water. North of Sherburn and South of Wykeham, Mr. Strangways remarks, and along the line of the dike called the New Hertford River between Willerby and Muston, there are several patches of dark *peaty* soil, which towards the East increase in thickness and become a true *peat*. These patches, locally called "Sulphur lands" were formerly mere swamps, but are now artificially drained and brought into cultivation, although they grow but inferior crops. At Ganton station there are 40 ft. of fine sand, resting on 20 ft. of fine clay, beneath which lie 10 ft. of hard *black* clay; at this point the railway begins to diverge from the river Derwent, as it flows almost due North and South from Forge Valley gorge. The line takes a North Easterly direction crossing the New Hertford River between two small plantations; the Catch Water and Robin's Bottom: and the centre of the vale, through which the Old Hertford river's course lies; it then passes through the Oolitic sands and gravels of the old Northern beach, which pass up beyond Seamer Junction, into the Mere valley, overlying the Boulder drift which surrounds them on either side. This is an interesting point, as both the remains of the Oolite beach and Boulder clay and gravels can be well studied in a gravel pit to the South-East of the Station. In the garden of the Station Master, is to be seen an enormous Boulder of Shapfell Granite, which during the glacial period was brought from the Cumbrian mountains, and deposited in the neighbourhood; it is a splendid monolith, having all the peculiar character-

istics of that far famed granite; and measuring fourteen and a half feet in circumference and seven feet in height. From this point the beauties of Scarborough begin, the traveller passing through the deep valley of the Mere, between Weaponness Rigg (Oliver's Mount) and Falsgrave Moor; the site of the once extensive Mere is traversed by the line, and what is left of that fine sheet of water lies to the East, under the wooded shelter of that grand escarpment—Oliver's Mount,—the bold northern end of which—more than five hundred feet above the sea level—is seen to abruptly rise above the platform on which the town stands; beyond this are Spring Hill on the west, noted for its waters, and then the beautiful Ramsdale is crossed just before the station is entered,—and thus ends an interesting and instructive journey from Malton to Scarborough.

If we now stand at the base of "The Keep," on Scarboro' Castle Hill, we shall be at a height of two hundred and eighty five feet above the sea level, and command a view rarely equalled: for it is indeed rare to be able to see, at our feet, two such lovely bays at the same moment and from the same stand-point; the expanse of the clear blue waters of the North Sea is beautiful in itself, but encircled, as they are, around these bays with lofty cliffs of almost every hue, the scene grows into one of grandeur,—the glittering white chalk cliffs that stretch at the South East to the magnificent promontory of Flamborough Head, form a back-ground to the nearer cliffs of Gristhorpe and Red Cliff, the latter being so called from the brilliant color with which the overlying drift has imbued its Calcareous grit two hundred and eighty feet above the beach. Then again, between Red Cliff and White Nab we see the cliffs of Osgodby Nab, three hundred feet high, their drift-capping covered with the brightest green and most interesting flora; the underlying sandstone rocks (upper Estuarine series) skirting the shore with thin pale yellow colour. Then comes the ravine made by the little rivulet, that forms the borough boundary at this point, with its sloping banks covered with luxuriant vegetation, the favourite haunt of flower lovers, for here Orchids abound, and the Grass of Parnassus rears its pale but stately flowers. Then, within the borough boundary, stands out *White Nab*, deriving its

name from the pale color of the sandstone (the upper Estuarine series) of which it is composed. The eye then falls on the lofty cliffs which are crowned by Scarborough itself, with its well built terraces, crescents, and hotels, looking down on the thickly planted cliffs and the beautifully wooded ravine of Ramsdale; Oliver's Mount and Seamer Moor forming a back ground worthy of the scene in front.

Turning to the North Bay are seen Blenheim and other Terraces, and the North Marine Hotel standing on the North Cliffs, which range from 200 to 100 feet, near the site of the Alexandra Hotel: These cliffs are composed of sandstones capped with boulder gravels, sands, and clays. At Peasholm, the beck which forms the North Western boundary of the borough, empties itself into the sea. Beyond this are seen Scalby Ness, and Long Nab, both composed of the sandstones which form the platform that is tilted up as I have described. The cliffs and promontories just named, have as a background the heights which form the Derwent Watershed. Thus we see in the far distance Pie Rigg How, and the Derwent Head Rigg, between which and the lower ground are seen Langdale Rigg, Hackness Moor, Silpho, and Suffield Heights, and nearer home Scalby Nabs. Such is the barest outline of a view that a true lover of scenery will never forget when once he has enjoyed it. If we now descend from Castle Cliff and take the road to Scalby, pass Scalby Nabs, then over Suffield Hill into Hackness, we shall find the heights composed of nearly the same strata as the one we have just left, as will be seen in the *Appendix* where a list of heights and their geological structure are given; the reader will be assisted also by referring to the chart of the protective boundaries on the map, which gives the direction of the different heights as seen from Scarborough. After passing Hackness we proceed to the North West, crossing the Derwent as it flows out of the dale between Langdale End Rigg and Hackness Moor, (the Western side of the beautifully wooded *island* already described); we then drive in the same direction as far as the Moor Cock Inn, opposite which is Howden Hill, that strange sugar-loaf-like detached hill at the Southern end of the rigg just named, and which we now flank along a rugged road of sandstone, cornbrash, and Kellaways rock, until we reach its

Northern extremity, having an altitude of 802 feet, whence a most magnificent view is commanded : from the foot of this height we then traverse a rugged pathway over the sandstone platform until we reach the shooting box on Derwent Head and find ourselves 950 feet above the sea that flowed at the base of Scarborough Cliff a few hours before : at this spot we stand on the highest point of the tilted platform of sandstone, on which all the heights we have passed rest ; and, as we look down on Scarborough in the far distance are impressed with the protective power of this range, and the influence it must exert over the climate of Scarborough. Whilst standing on this elevated point, we see in the distance, Old Peak, Low Moor, Pie Rigg, Lilla Cross, Saltersgate Nab, Whinney Nab, and that never to be forgotten hill—like a truncated sugar loaf—Blakey Topping. Whilst the horizon is broken by the great outer protective boundary, of which Burton Head and the other heights named above, form a range averaging between 1,400 and 1,500 feet. If we now refer to the list of heights between us and Scarborough, we shall find that the process of denudation or destruction of the strata above the sandstone platform divides the area into zones, each zone as we descend to the vale of Pickering, giving evidence of decreasing destruction, until we find the highest members of the Oolitic series, the Kimeridge clay, (Upper Oolite) actually dipping under the ancient beach of the estuary, which once occupied the site of the vale of Pickering ; in fact, the Derwent in its course from the gorge of Forge Valley, cuts its way through these higher members of the Oolite series before it leaves this lovely valley to take its course through the latter deposits, which for so many ages its waters have contributed, and with which this extensive area has been filled since the sea ceased to flow into it, owing to the elevation and silting up of the inlet to the South of Filey Brigg. Thus have I briefly sketched this interesting area, imperfectly, it is true, but sufficiently to show how much there is to interest all who visit Scarborough, and who desire to see for themselves those features in its physical geography and geology that have such an important influence on its climate, and its suitability as a health resort of the first class.

SECTION V.

THE CLIMATE OF SCARBOROUGH: ITS WINDS—WITH A DESCRIPTION OF THE WIND CHARTS, SHEWING THEIR MEAN MONTHLY, SEASONAL, AND ANNUAL RELATIVE PREVALENCE.

THE observations as to the direction of the Wind have been tabulated for the five years, 1877—1881, and the results I have endeavoured to present in such a form around the map as to enable their being studied in conjunction with the physical features of the town. The *Wind Charts* that I have constructed for this purpose are of three kinds. 1st.—A series of *twelve* Charts shewing the *mean* number of days the Wind from each of the eight quarters N., N.E., E., S.E., S., S.W., W. & N.W. blew every month during the five years of observation. 2nd.—A series of *four* Charts shewing the mean relative prevalence of the Winds during the four Seasons, viz.: *Winter*, consisting of December, January, and February; *Spring*, of March, April, and May; *Summer*, of June, July, and August; and *Autumn*, of September, October, and November. 3rd.—A Chart shewing the mean annual number of days the winds blew from each of the eight quarters during the above period. On this Wind Chart for the year the names of some of the countries, localities, and seas are indicated over which the several winds more or less blow before reaching Scarborough; an important point that ought to be always well considered, when studying a local climate, for the extent of either land or water that a wind traverses materially affects its temperature, moisture, and other important features.

A Scale of Days accompanies the Charts, besides which,

NORTH BAY, SCARBOROUGH.

there are figures at each point representing the number of days the different winds blew.

The Relative Prevalence of Winds at Scarborough.—It is convenient for the purposes of comparison to divide the winds into *Easterly* and *Westerly*; on the coast, however, it is well also to distinguish between the *land* and *sea* winds, when we have to consider the characteristics of the local climate.

Of the 1822 days on which wind observations were recorded during the five years, 1877—1881, the *Easterly* (N., N.E., E., and S.E.) blew on 707 days, whilst the *Westerly* (S., S.W., W., and N.W.) did so on 1115 days. During the *four Seasons*, the *Westerly* prevailed in three—Winter, Summer, and Autumn—thus they occurred in December, January, and February on 345 days, and the *Easterly* on 103; in June, July, and August on 266 and the Easterly on 194 days; and in September, October, and November on 298, and the *Easterly* on 156 days: in March, April, and May, however, the spring months, the *Easterly* winds were recorded on 254 days, whilst the *Westerly* were experienced on 206 only: the tables, however, will show that the months April and May were the only two out of the twelve during which the Easterly winds predominated.

It will be seen, however, from the annual Wind Chart, that all these Easterly winds—from the South East to the North—must travel over a wide expanse of sea before reaching Scarborough from the Continent, the shortest route being that of the first-named wind, from the coasts of Belgium and Holland, a distance of 250 miles; whilst the East traverses 370 miles from Schleswig Holstein, the North Easterly at least 450, and the Northerly over an almost limitless ocean with the gulf stream intervening; this cannot be said of those portions of the continental winds which impinge upon our coasts to the South of Scarborough. The North Sea used to be called by mariners "The Great Tunnel or Funnel," on account of its great width to the North, gradually lessening Southwards, and, as it were, tapering funnel-like to the Straits of Dover. Now as Scarborough is opposite the wide end, all land winds leaving the coast of Western Europe have the chance of rehabilitating themselves with

some of that marine character, of which they had been deprived whilst passing over the great continental area of Northern and Central Europe: a chance that decreases in the direct ratio with the Southern lowering of the latitude.

We may then state generally that the *mean annual per Centages* of these two classes of winds are as follows, *calm* days, however, on which no observations as to their direction were made, must be taken into account: during five years 1877-1881 there were taken at Scarborough 1826 observations, when the *Easterly* winds amounted to 38·7; the *Westerly* 61·0, and *Calms* 0·3 per Cent. = 100.

It must be remembered that all winds so called, are neither *East* nor *West* winds exclusively, but winds that come from any point from North to South by East, and those that reach Scarborough from the points between South and North through West.

Again, if we compare the relative prevalence of these two great classes of winds at Scarborough, with what obtains on the South and West coasts, we shall find that this Health Resort has no more than its due share of each, although on the East coast, and moreover that it is frequented *less* by the Easterly class than many resorts on the *South* coast, which hitherto have been popularly extolled as appropriate for *Winter* residence.

The practical value of the wind statistics that I have already given, and of those which I shall subjoin, will be seen, when they concur to prove that Scarborough is eminently qualified for a *winter residence*. A fact that has long been known to medical men and others, who have *studied* its climate, but one that has not been sufficiently appreciated by the public, who have been too much led away by the pretensions of other resorts, based upon their more southern latitudinal position, regardless of their more continental character, and their being subject to winds having continental features. For instance, the Easterly winds which blow over the resorts on the South coast are eminently less marine than those that blow on the Scarborough coast, for they not only have a very short sea passage, but on their arrival in England have to traverse land again: this we know is not the case with those that we have just been discussing. I have long enter-

tained the opinion that Scarborough deserves to be better known as a Winter Resort: its winter temperature, its winter winds, and its physical geography, all entitle it to a high place as such; and I am glad to find that later meteorological observations, made with the best and most modern instruments, fully confirm the opinion entertained and expressed by John Phillips, F.R.S., thirty years ago. This opinion I shall quote, as it was formed by one who had made the natural history of Yorkshire the study of his life.

"Scarborough," writes this author, "is readily admitted to be supreme among Northern Watering-places. No situation on the Yorkshire coast offers the same continuation of picturesque cliffs, convenient access, comfortable dwellings, amusements for invalids, and *motives* for exercise to the more robust, along pleasant sands, among ancient fortifications, over prominent hills, or through woody valleys." * Again, "Masses of elevated land, and broad tracts of deep water, affect climate by giving out, in late autumn and winter, some warmth which they had acquired in summer,—hence one of the advantages to the invalid of a *prolonged residence* in Scarborough, or in some sheltered Yorkshire dale, till December, January, and even February,—have spent their cooling power on the inland surfaces."

The Meterological year commences with winter,—December, January, and February,—during this season the tables show us that the *Westerly* winds prevail at Scarborough to the extent of 77 per cent.; the Easterly to less than 23, there being 0·6 per cent. of calm days. The *Winter* Wind-chart shows at a glance how these Westerly winds were distributed, and what were the mean number of days on which they occurred: from the *North West* 9·6, the *West* 31·8, the *South West* 14·8, and the *South* 12·8 days: 69 days in all, leaving only 21 possible days for calms and the opposite winds, on which the *North* blew on 8·4, the *North East* 3·4, the *East* 6·2, and the *South East* 2·6 days only,—so that, with the exception of the 9·6 days on which the *North West* blew, all the other Westerly winds were from points between *South* and *West*,—winds that we know bring heat and moisture from the Gulf Stream. Why the *West* winds should prevail over the South West is a question easily solved

* "The Rivers, Mountains, and Sea coast of Yorkshire." 1853, pp. 133-135.

by a study of the inner and outer protective boundaries described in a previous section.

It must be borne in mind however, that, from observations which I have collected from forty Meterological Stations in the British Isles—extending from the Orkneys to Jersey—the West winds are really the prevailing winds, although not to the extent we find them recorded at Scarborough. It may be interesting at this point to give the results of my enquiries as to the relative prevalence of the winds over the British Isles during 1878-1879.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	C'lms
East Coast	36·0	35·1	28·1	21·4	32·1	69·2	66·4	31·4	45·3
West Coast	42·3	30·2	57·1	28·8	36·1	54·2	69·6	29·7	17·0
South Coast	46·4	55·2	34·5	14·8	35·4	72·4	59·9	29·5	16·9
British Isles	42·9	36·0	33·8	23·3	35·5	62·6	66·2	35·8	28·9

The above figures have been obtained from 58,400 morning and evening observations. The *West* wind reaches its greatest prevalence at Scarborough in winter, and is recorded more frequently in December than in any other month of the year, in fact it was noted to have blown 65 times during this month in the five years, or at the rate of 13 days out of the 31. I have also constructed a table of the relative prevalence of the winds for the years 1877-1881, at York, kindly furnished me by the Curator of the Yorkshire Philosophical Society's Museum, and the wind chart, the result of these tables, has a strong resemblance to that for Scarborough, differing, however, in some important particulars, which will help to show how the physical conformation of a country determines the direction of aërial currents. In the first place, although the *West* was the most prevalent wind at York during this period, it was considerably less so than at Scarborough, where the mean annual number of days was 103·2, whilst at York it was only 79·6. Whereas, the *South* wind is stated to have occurred at the rate of 72·3 days a year at York, whilst at Scarborough it was observed, on an average, of 48·6 days. At York there is no considerable river or other valley that could materially affect the average general prevalence of the *West* wind, by deflecting other winds,—on the contrary, the valley of the river Ouse to the South of York, has its axis nearly, if not quite, in a North and South

direction, hence there is no difficulty in accounting for the deflection of the Southerly winds up the vale of York, into the valley of the Ouse, and thus giving an apparent preponderance to the *South* wind : when, however, we come to the causes of the prevalence of the *West* wind in Scarborough, and the less number of *South* winds, when compared with York, we have but to consider how *South* and *South Westerly* winds would act after passing out of the vale of York ; some portion would undoubtedly pass up the gorge of the Derwent near Malton, enter the vale of Pickering, and find their way to Scarborough up the valley between Oliver's Mount and Seamer Moor : this would be the course of moderate winds ; but winds of greater force would sweep over the lower heights and take their course to the moorlands in the North Riding, where to the North West of Scarborough they will meet with that great outer protective boundary, having an altitude of 13 or 1400 feet, consisting of Burton or Bottom Head, above Ingleby Greenhow (1485 feet), Cranimoor (1423 feet), Farndale Head (1412 feet), Loose Hoe Moor near Rosedale Head (1404 feet), The two Hows, between Bransdale and Farndale Head, (1380 feet), Howdale Head (1746 feet) Carlton Bank (1325 feet), Cola Moor (1314 feet), and Whainstones, west of Burton Head (1300). These Heights, which form a range having its axis in an East and West direction would have the effect of diverting the winds so that the South Westerly would be converted into a Westerly direction, and this would be materially favoured by the direction of the parallel Tabular Oolitic Hills commencing at Filey Brigg and forming a number of bold escarpments, as described by Phillips, from Oliver's Mount to Hambleton End. Then again the Ryedale and the Vale of Pickering form an extensive valley in the same direction, and are flanked by the Yorkshire Wolds to the South, having their main axis in an East and West direction : to that the whole of the area is traversed by heights and valleys, having their axis in a direction tending to convert Southerly winds into Westerly, and Northerly into Easterly. All this impinging on elevated masses, such as I have described, has still another effect on the winds, for whilst in contact with them they collect what heat yet remains of their summer

store, and convey it to the town. The *true* Westerly winds have the shortest land route of any of the winds; they come across the narrowest part of England from the Atlantic Ocean, and lose but little of their essential character; the true South Westerly winds, too, reach Scarborough long before their temperature and moisture are much reduced, so that the chief characters of the winter months up to the end of February, are warm winds from the South to West points, and only an occasional visit of the North Westerly land winds, and those that come from the sea. It is very evident therefore, that the winter at Scarborough could be enjoyed with advantage to a much greater extent than has hitherto been the case.

During the *Spring* months, March, April, and May, the winds afford the greatest contrast possible to those of the Winter: the *Sea* winds prevail. In March, however, the West wind is still the prevalent one; the North Westerly winds, which traverse the longest and coldest land route from Scotland, are almost equally prevalent with the North and East winds: all these winds are dry winds and descend upon this part of England as heat and moisture collectors; they therefore reduce both these climatic elements. In April the West winds reach their *minimum* of prevalence, and the East their *maximum*; but the reader must remember what has been previously stated, that the number of days, on which *East* winds were recorded, is in excess, for many were diverted winds, that is winds from the North Easterly and South Easterly points converted into an Easterly direction, in consequence of the physical conformation of the land.

The elevated mass of Castle Hill, has a powerful effect in shielding a large portion of the town from the North Easterly winds, and that portion of the town called the *North Cliff* from the direct *East* winds. Within the borough, too, ample shelter from the East winds is to be found on the West side of Oliver's Mount.

In *April* the Easterly winds reach their maximum number of days, the East being the prevalent one; in *May* the winds are *North*, and it is during this month that the North winds reach their maximum prevalence, and the West winds more than counterbalance the East. During the *June* month the West winds begin to increase again, and in *July* attain

their maximum prevalence; at this season, however, the Westerly and Easterly winds are more equally balanced than at any other; the North winds remain very constant, and impart a refreshing coolness from the sea, most grateful in the heat of Summer. In the *Autumn*, the Westerly winds increase in prevalence, but are to a certain extent counterbalanced by the North winds. The charts, however, show these changes at once and more clearly than any verbal description.

The chief characteristics of winds are modified much by the physical features of the country over which they pass before reaching the station where they are observed and recorded; on this account every locality has its own peculiar climate, and even this climate is made up of a variety of modifications, the number of which is in the direct ratio of the multiplicity of aspects, caused by the inequality of the area, on which the sun shines, and over which the winds blow.

The coldest winds at Scarborough are, necessarily, those which reach it after having passed over the *longest* tract of *Northern* land; these winds, it will be seen by the Wind Chart of the year, are between the points *North by West* and *North West*, after leaving the North Atlantic Ocean, they cross over Scotland, Northumberland, and the Moorlands of the North Riding. They are not only the coldest but the driest winds, they absorb both moisture and heat, which the following facts prove:

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
45·7°	46·2°	48·5°	47·7°	48·4°	50·4°+49·8°		45·4°—

From the above it is seen that the North Westerly, or more strictly the N. N. W., are the coldest throughout the year, and this point corresponds with the longest line that can be drawn over land from Scarborough to the *North* Atlantic; whilst the South West and West are the *warmest*, as they pass the shortest overland route between this station and the warm current of the Gulf Stream. In January, the N.W. winds depress the temperature to 33·6, whilst the W. raise it to 42·2, and the S. W. to 40·5. In July the N. W. cools the summer temperature to 60·7°; whilst the S. W. raises it to 62·7°, and the East to 63·5. In January the mean

air temperature, under the influence of this last wind, is 1·6 higher than under that of the North West winds. Now, I have just shown that the W. and S. W. winds prevail during the winter months, and their doing so up to the end of February, warrants me in believing that Scarborough is well adapted for winter residence. If we compare its Winter Wind chart with that of Brighton, we shall see at a glance that so far as winds are concerned, Scarborough does not hold an inferior place to that well-known Winter Resort. The mean number of days, on which the winds blew at the two places, during the *Winter* Season, 1877-81, will show this fact. The Wind Charts for the Seasons at Brighton, have just been published in my "Health Guide Map," for that Seaside Health Resort.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calms
Scarbro'	8·4	3·4	6·2	2·6	12·8	14·8	31·8	9·6	·4=90
			20·6				69·0		
Brighton	16·8	11·8	7·2	3·6	8·6	11·6	16·0	8·2	6·2=90
			39·4				44·4		

The Driest and Moistest Winds.—From a long series of observations the following facts have been elicited, as to the influence of the winds on the mean moisture of the air in the North Riding of Yorkshire, they are applicable to Scarborough and therefore I subjoin them.

N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
48·54 –	54·43	52·75	62·71	+62·30	54·26	54·39	51·56

Here we find the greatest amount of moisture coming from the most Southerly wind that blows over Scarborough, direct from the sea without any intervention of the land, viz: the *South East.* The *South West* winds lose some of their moisture in passing over the Derbyshire and West Riding heights. The *South* wind however passes over some of the flattest parts of England before reaching Scarborough, and therefore, we find it ranking next to the S.E. sea wind. Between the N. and N.W. points the driest winds come, and even the North East wind is a moister wind than the East in consequence of its more marine character, it travels over between 400 and 500 miles of sea before reaching the North

Riding coast, and the winds from N.E. by N. to N. have to cross an almost unlimited sea.

The temperature diagram on the map shows how the rainfall is influenced by this prevalence of the Southerly and Westerly winds, during the last six months of the year.

The *Force of the Wind*, and how the protective boundaries of this borough militate it, has been already referred to in the introductory section, in which I have treated generally the geographical distribution of Consumption in England and Wales, and shown why the climate of Scarborough is so well calculated for the residence of those who are unfortunately hereditarily or otherwise tainted with this fatal disease.

SECTION VI.

The Climate (continued).

Mean, Monthly, and Annual Temperatures.—In the lecture which I delivered at the Old Town Hall, on the 31st of July 1882, I was able to give only a bare outline of the mean, monthly, and annual temperatures observed at Scarborough; I will however now enter more into detail and give the results of the observations which have been made during the last fourteen years, a careful summary of which has been kindly furnished me by the gentleman who has charge of the Meteorological station belonging to the Corporation, W. C. Hughes, Esq., F.M.S., of St. Martin's Square, to whom I beg to make my best acknowledgments for the completeness and readiness with which he supplied me with the data that I am now about to use.

Mean temperature is that degree of heat which is found on adding together the highest and lowest readings of the thermometer during a day of twelve hours, say from 9 a.m. to

9 p.m., and dividing the same by 2: the same process is carried out for the night readings, the two sums are then added together and divided by 2 also; the result is the mean temperature for the 24 hours. This, as we shall presently see differs materially from the *range of temperature*, a most important factor in a climate, when we have to select one for an invalid, a knowledge of the mean temperature alone of a locality would be of little service in the selection of a climate unless we know the amount of its daily range. We may have the same mean daily temperature in two localities, having vastly different climates; for instance, two places may have a mean temperature of 72·8° made up thus:—in the one the mean day temperature may be 86·2°, and the mean night temperature 59·5° mean 72·8°. In the other the mean day temperature may be 77·6° and the mean night temperature 68·0° mean 72·8°*. This mean temperature therefore teaches us nothing as to the real difference in the climates of these two places, or their fitness for an invalid: if however we test them by their *range* of temperature, thus we are at once let into the secret, why one is suitable and the other totally unfit as a health resort. In the first we find the difference between the day and night temperatures to be 26·7°, and in the second only 9.6° or a difference in the range between the two places of 17·1°.

The Mean Temperature at Scarborough.—The figures which I am about to use are the result of fourteen years observations; the details for the last five years will be found in the Appendix with the other Meteorological Tables.

The simple statement that a locality has a certain mean temperature during certain months or seasons is, as I have proved above, not all that is necessary; I will now endeavour to show the importance of comparing the known facts in the climate of a health resort with facts of the same order in other localities. This, as I showed in my lecture, can easily be done, so far as mean temperatures are concerned, by means of *isotherms*, which resemble the *contour lines* on the map; in the one instance the lines represent equal levels, in the other equal temperatures: so that when the word *isotherm* or *isothermal lines* is used, it will be for the purpose of connecting with Scarborough some distant portion of the British Isles.

* See another illustration further on, where it is shown that although the mean annual temperature of the sea and air are within a few tenths of a degree the same, yet their ranges of temperature differ widely.

*The Mean Annual Temperature of Scarborough.**—This has been found to be 47·6° Fahr. from observations extending over fourteen years, and even if we take the mean of the last five years 1877-1881, a difference only of 0·3° is shown although during that latter period the weather has been exceptional in character. The mean annual temperature is due to the refreshing coolness of the summer months, the result of the peninsular character of the site of the town, which is bounded on two sides by the sea. The mean temperature of Scarborough when compared with the *inland* town of York shows this fact prominently: for instance, during January, February, March, October, November, and December, the mean temperature of each of these months is *higher* than that of the same months in York, to the extent in the aggregate of 11·7° Fahr.; whereas during April, May, June, July, August, and September, the mean temperature is *lower* than at York to the amount of 14·6° Fahr. Again, if we compare the observations taken nearly in the same meridian on the coast of the English Channel, we shall find that the summer months are each between three and four degrees hotter than at Scarborough, whilst none of the winter months have a mean temperature above Scarborough amounting to one degree of Fahrenheit, although the two stations are separated by more than three degrees of latitude. This summer coolness and winter warmth give a character to the climate of Scarborough, which has earned for it so much of its reputation. We must now see how this mean annual temperature is constructed by taking the mean temperatures of the months in succession.

The Mean Monthly Temperature of Scarborough.—During the Winter Months the climate of the British Isles is influenced by the Gulf Stream, and this influence is felt on all their coasts. One of the results of this warm sea current is to link, as it were, the Southern with the Northern parts of England, and to bridge over during the winter the intervening interlatitudinal spaces or zones, as we shall presently see.

In January, when the mean temperature is 38° at Scarborough, we find that the line representing this degree of

* Represented by the dotted line in the diagram showing the Temperature.

heat (isotherm)* extends as low South as Walton-on-the-Naze, and lies within the 37° isotherm, which characterises the coast on which Cromer and Yarmouth are situated. January is the coldest month in the year. The Westerly and South Westerly winds prevail.

In February the mean temperature is 39·8°, this degree brings Scarborough within the isotherm 39° and 40°, within which lie the more Southern resorts on the coast of Norfolk and Suffolk. February has the least rainfall of all the months. The Westerly and Southerly winds prevail.

In March, when the mean temperature is 41·3°, Scarborough is colder in comparison than the coast south of Cromer; but it is linked by this degree, with the Lake district of Cumberland, the north of the Isle of Man, 54° 25' Lat. N., and with Belfast and the north of Ireland. The prevailing wind is the West, but the North and East winds begin now to show their influence.

In April the mean temperature does not make the advance which the season would warrant us to expect: the mean of 14 years is only 42·3°. This month however fluctuates much, and the real mean can only be established by at least 14 or 15 years. For the last 5 years the mean temperature for this month was 43·6°, which will not place Scarborough for this month lower than the Orkney Islands. The prevailing wind in April is the East which has quite superseded the prevalent winds of the then preceding months. No visitor or invalid should go to Scarborough for the first time this month.

In May the mean temperature of 49·9° still links Scarborough with the Northern parts of Scotland, the Western Islands, the Moray Frith, etc. The prevailing wind is the North, and the number of days on which the East wind blew in April is lessened by one-half in this month.

In June the mean temperature is 55·8, and this degree still keeps Scarborough linked with the Scottish coast. The Westerly and Southerly winds now begin to counterbalance the Northerly and Easterly.

In July the mean temperature 60·2, and this degree links Scarborough with Llandudno, Bangor, Beaumaris in the

* The Isotherms here and hereafter referred to are those published in the Journal of the Scottish Meteorological Society, to illustrate a paper on "The Temperature of the British Isles," by Alexander Buchan, M.A., F.R.S.E. Calculated on a mean of 13 years (from January 1857 to December 1869 inclusive).

North of Wales, the West coast of Wales, and the central part of Ireland from Belfast to Dublin. The West wind is the predominant one.

In August Scarborough is as cool as the South of Scotland and the North of Ireland, owing to its mean temperature of 58·7. The winds from the Westerly to the Southerly points prevail, and more than counterbalance those from the opposite quarters.

In September—when we have entered this month we have seen the last of the Summer, but a splendid season is still before us—the mean temperature of Scarborough during this month is 54·9. Still cool, and resembling that of the North of Ireland and the South of Scotland. The two prevailing winds are the West and North.

In October the degree of 48·5 still keeps Scarborough linked with the North of Ireland and the Central part of Scotland. The prevalent wind is the North, and the next frequent the West.

In November a change begins to take place, the Westerly and South Westerly winds prevail, and we find the mean temperature of the month 42·7, uniting Scarborough with a large area having more Southerly latitudes. For instance, with the Centre of England before it has been cooled down by the winter frosts and snows, Birmingham, Stafford, Derby, Manchester, Leeds, Kendal, and the Lake District, and the North of Ireland. The prevalent winds are the Westerly and South Westerly.

In December—the first month of the winter season—we find Scarborough having a mean temperature of 38·8 or only 0·5 less than is found on the South coast of England on the same meridian--the prevalent winds are Westerly and South Westerly.

We will now compare the mean temperatures of Scarborough for each month with a station on the *South* coast of England on nearly the same meridian but 3° 25' of latitude more to the South. The observations at both stations extended over 13 years, and comprehended the same period, viz., 1868-1880.* It must be remembered that the 14 years period represented in the diagram, included the exceptionally cold winter of 1881.

* For the Scarborough mean temperature see Dr. J. W. Taylor's Annual Report for 1881, p. 4.

The Southern station, to which I have alluded, and with which I am about to compare the climate of Scarborough, as regards its monthly mean temperature, is Brighton, which lies on the parallel of 50° 49′ 56″ Lat. N.; Long. W. 0° 9′ 13″; whilst Scarborough (the centre) lies on the 54° 16′ 15″ Lat. N.; and the meridian of 0° 24′ 24″ Long. W.

	Scarborough 13 years, 1868-80.	Brighton 13 years, 1868-80.	Difference Scarborough
January	38·6	39·2	−0·6
February	39·9	40·7	−0·8
March	41·3	42·5	−1·2
April	45·7	48·0	−2·3
May	49·8	52·6	−2·8
June	56·0	59·3	−3·3
July	60·1	63·4	−3·3
August	58·9	62·8	−3·9
September	55·0	58·3	−3·3
October	48·7	51·0	−2·3
November	42·3	43·3	−1·0
December	38·8	39·3	−0·5
	47·9	50·0	−2·1

From the above it will be seen that whilst the winter months, December, January, and February, have a monthly mean temperature in Brighton of 39·7°; the same season in Scarborough has one of 39·1 or is only 0·6 colder than the more Southern resort. Again, if we take the summer months, when visitors and invalids are glad to escape the greater heat of inland localities, Brighton has then a mean temperature of 61·8°, against Scarborough 58·2°, or is warmer by 3·6° than the Northern resort. Brighton, however, in this respect, compares very favourably with other places on the same coast.

As regards temperature, it is very certain that the Season of Scarborough might very well be prolonged far through the winter; and presently we shall see that for other reasons also, this might not only be done safely but with advantage to the invalid.

The mean highest (maximum) and the mean lowest (minimum) Temperatures. The range of Temperature at

Scarborough.—We now have to discuss one of the most important subjects connected with the climate of this resort. In the description of the Physical Geography of the town and neighbourhood, I have drawn attention to the large masses of elevated land, that not only characterise the *Inner* and *Outer Protective Circles* of this borough, but to those that intervene between them. These I shall presently show have not only a protective influence against the force of some of the prevailing winds, but are actually so many reservoirs of the summer heat, and conduce materially in *postponing* the rigour of winter until the sun of returning spring has attained an altitude which enables it to mitigate its severity. Before, however, I enter upon this most interesting subject we must direct our attention to the diagram representing the mean maximum and minimum temperatures of each month; the mean monthly temperatures, and the mean temperature of the *sea* for each month. In the first place we must note that the temperature of the *air* is *coldest* in *January* and *hottest* in *July*. This is almost universal throughout the British Isles, and is one of the best known facts in climatology, connected with the *postponement of the Seasons:* an exception, however, may be found in the climate of Bressay, in the Shetland Isles, where, from thirteen years' observations, it is shown that *March* is the coldest and *August* the hottest month; a significant fact, the importance of which will be seen when we come to the temperature of the sea.

The *darker* shade in the diagram indicates the rise and fall of the mean *lowest* temperature for each month, the *lighter* shade, the same for the mean *highest* temperatures; and the *breadth* of this *lighter* shade also shows the *mean range of temperature* for each month. The dotted line ..... indicates the mean monthly temperature of the *air*, and the —.—.—. that of the *sea*. Besides the lines, which are regulated by a scale on the left, the temperatures are superadded in figures, and in the Appendix will be found the details of the observations.

The Range of the Temperature of the air at Scarborough.—By this element we may know whether a locality has an *insular* or a *continental* climate—the two widely differ from

each other—and the following propositions may be accepted as well established laws in climatology.*

1.—In the Northern hemisphere, places which enjoy a *maximum* mean annual temperature, have also a *minimum range* of annual temperature; *i.e.*, they have an *Insular* climate.

2.—In the Northern hemisphere, places, which possess a *minimum* mean annual temperature, have also a *maximum range* of annual temperature; *i.e.*, they have a *Continental* climate.

3.—Large masses of *land*, anywhere, *increase* the *range* of annual temperature; and large masses of *water*, anywhere, *diminish* the *range* of annual temperature. †

Now it is very evident that the closer the climate of a locality approximates that of the *sea*, the less will be its *daily range* of temperature, and that in the direct ratio of that approximation will be its suitability for the invalid. After dealing briefly with the tables, showing the mean, highest, and lowest readings of the thermometer at Scarborough, as well as with those which the absolute extremes of heat and cold, which have occurred during the five years, 1877-1881, we shall be in a position to understand how these tabulated observations bear upon the range of temperature.

With regard to the mean hottest, and mean coldest periods of the year, we find that the crest of the *heat* wave culminates in July at 64·6° Fahr., and that its trough passes through January when the mean greatest depression in temperature is found to be 33·6° Fahr.—thus giving a mean range from the hottest to the coldest period of the year of 31·0° Fahr. When we deal however with the *absolute* highest and lowest readings of the thermometer, we must expect to find a greater absolute range, for instance, if we take the exceptionally cold winter and hot summer of 1881, we shall find a remarkable

* Six lectures on Physical Geography, by the Rev. Samuel Haughton, M.D., F.R.S., &c., &c. p. 120, Longmans, 1880.

† It is interesting to note that at Bressay, Shetland, 60° 10′ Lat. N., and 1° 10′ Long. W., the coldest month is March 38·3°, and the hottest month is August 54·8°; the January and July temperatures being 38·9° and 53·4° respectively. This postponement of the season is in accordance with what takes place in the sea. A similar postponement is recorded in the Isle of Man, where, at the extreme points of the island, from observations extending over 17 years, it is shown that February and August are the months of extreme temperatures—thus, the mean temperature for January is 40·9°, that of February 40·7°, whilst in July and August the mean temperatures were 56·3° and 57·4° respectively.

range not only in Scarborough but throughout England. In Dr. J. W. Taylor's Annual Report for 1881, p. 4., this range was alluded to as follows: "From 10½ degrees, which was the coldest point in January, up to 81 degrees, the warmest in August we have a difference of 70½ degrees, a large range for sea coast places—larger in fact than has occurred here during the previous 13 years." Even during these two periods of extremes of cold and heat, Scarborough was only one degree and-a-half colder than Truro (12·0°), nine-tenths of a degree colder than Brighton (11·4°), one degree and seven-tenths colder than Bournemouth; whilst it was 4½ degrees warmer than Hull (6.0o), and one degree and three-tenths less cold than Lowestoft; besides which, the range between the extremes, winter and summer, was not so great as at either of these places; for instance, at Scarborough it was 70·5°, at Truro 71°, Brighton 75·3°, Lowestoft 77·8°, Hull 78·0°; the highest July readings for these places, viz: Truro 83.0°, Brighton 86·7°, Lowestoft 87·0°, and Hull 84·0°. Considering the difference in latitude between the Scarborough coast and that of the South West of Cornwall, it is important to know why Scarborough should have registered 10 degrees of frost only, when places to its South, West, and North, were all recording lower degrees, and Truro, more than 4 degrees of latitude nearer the Equator, enjoying the full influence of the Gulf Stream on all sides, should at this same time have been only 1½ degrees warmer, and Brighton only nine-tenths of a degree warmer is a question, for the solution of which, reference must be made to the section on the physical geography of this watering place, where the peculiar factors of the climate of Scarborough have been treated. I may however remind the reader, that the prevalent winds of January blow over, during this month, the extensive elevated masses of land which form its outer protective boundary, and act as storers of the summer heat, which they not only part with from their surface by radiation, and contact with these winds, but which they send forth in all directions from the numberless warm springs, that cross our path at all points, flowing down the valleys, and imparting to them the warmth that they bring with them from the very centres of these grand store houses of the preceding summer heat.

As this range of daily temperature is so important an element in the climate of a health resort, it will be necessary to enter into detail with regard to it. In the first place it is laid down as a law that large masses of water anywhere diminish the range of temperature. Our large mass of water is the sea, about the internal climate of which I must state a sufficient number of facts to make its influence evident.

In the diagram of sea and air temperatures, it will be seen that the mean annual temperatures of the sea and air are nearly equal; that of the air at Scarborough being 47·6°, whilst that of the sea, which so surrounds it as to render it a *peninsular*, is 47·0°, or a difference only of four-tenths of a degree. When, however, we compare the annual range of the sea temperature with that of the air, we find a marked difference; for instance, the mean range of the air temperature was in the exceptional year, 1881, 9·7°, whilst that of the sea during the same period was 7·4°, or 2·3° less. Now if we compare the extreme mean temperatures of the sea and air, we shall find that they not only differ in degree, but in the time of the year they occur. We have seen that the extremes of the air temperature occur in January and July, whilst those of the sea take place in February and August; in fact the sea summer and winter are *postponed* nearly a month later than those seasons are found to be in the air.

The highest mean temperature in the air is, as we have seen, observed in July, when it amounts to 64·6°, and the lowest mean temperature takes place in January, when it falls to 33·6°, whereas the sea is warmest in *August*, 54·6°, and coldest in February, 40·4°; thus the extreme range in the air amounts to 31·0°, whilst in the sea it is only 14·2°.

Except for the year 1881, I am unable to give the *daily* range of temperature of the sea; in this year the least took place in February, 0·2°, and greatest in October, 4·6°. In the air during the same year the least range took place in January, 7·1, and the greatest in July, 13·8°.

The range of daily temperature varies with the seasons, which will be apparent from the following statement, in which I have compared that which obtains at Scarborough with what has been recorded for other stations, both coastal and inland.

During the *first* quarter of 1881 the greatest range of temperature was observed at Salisbury, 15·5°; Stockton, 14·9°; Gloucester, 14·7°—*mean*, 15·0°. The *least* at *Scarborough*, 7·4°; Llandudno, 8.6°; North Shields, 8·7°; *mean*, 8·2°: *difference*, 6·8°. During the *second* quarter the *greatest* range was at Salisbury, 26·3°; Stockton, 22·4°; Gloucester, 22·5°; *mean*, 23·7°. The *least* at *Scarborough*, 11·8°; Llandudno, 12·1°; Lowestoft, 12·3°; *mean*, 12·0°; *difference*, 11·7°. During the *third* quarter the *greatest* was recorded at Salisbury, 22·8°; Stockton, 21·3°; *mean*, 22·0°. The *least* at Llandudno, 9·7°; Liverpool, 10·4°; *Scarborough*, 11·8°; *mean*, 10·6°; *difference*, 11·4°. During the *fourth* quarter the *greatest* range was at Salisbury, 17·7°; Stockton, 14·0°; *mean*, 15·8°. The *least* at *Scarborough*, 7·9°; Llandudno, 9·3°; at Brighton, 9·1°; *mean*, 8·7°; difference, 7°·1. These figures are conclusive as to the difference in range between coastal and inland stations, and at the same time show how well the climate of Scarborouugh comes out when compared with that of other places on the coast: taking the first rank in three out of the four seasons.

It is interesting to trace the line of the mean temperature of the sea, and to note how, in the two coldest months in the year, January and December, it rises above even the mean maximum line of the air temperature, thus showing how this great reservoir of the summer heat must temper the winter of this *peninsular* health resort, as we have just seen from the figures above; and again, to follow it through the summer months and note how it descends even below the line of the mean lowest temperature in July, thus reducing the temperature of the hottest period of the year, by sending forth its cooling sea breezes over the adjacent land by day, mitigating the sun-heat, and refreshing alike the strong and the weak, and every plant and tree that clothes the beautiful country around, abounding, as it does, in moors and dales watered by numberless rivulets, having their sources in highland springs, which, at this season, are not only the purest but the coolest of waters.

Small as the daily range of temperature is, I believe it would be still further reduced by carrying out my proposition with regard to the valley of the Mere, viz.: to restore it, as

far as practicable, to its original dimensions, to deepen it, to drain the adjacent land, and plant as many trees as possible. This valley, from its position, forms an important physical feature, and may affect the climate of the town in two ways : *First*, if the low land around the Mere is allowed to remain *undrained* and *bare* of trees, evaporation and radiation will tend to reduce the night temperatures, and produce frosts when the high lands are free from them ; the cold stratum of air would then be brought into the town by any of the Southerly winds which pass directly through the valley. *Second*, if the body of water be increased in the Mere, the land drained, and the low lands covered with trees, all this cooling down would be obviated, and the temperature of the whole area be raised. The drainage would reduce the amount of evaporation, and the trees, besides lessening the cooling effect of terrestial radiation and evaporation, would store up for the night the heat of the day. It will be well to quote a high authority on this subject, Mr. Alexander Buchan, M.A., F.R.S.E., who in speaking of the influence of forests on climate, says "that the effect of vegetation in changing the hours of the distribution of the highest and lowest daily temperatures is most strikingly exemplified in the case of forests. Trees are like other bodies, heated and cooled by solar and terrestrial radiation. *They do not acquire their maximum temperature till a little after sunset.* This occurs in summer at 9 p.m., whilst the maximum temperature of the air occurs between 2 and 3 p.m. Hence trees may be regarded as *reservoirs*, in which the heat of the day is stored up against the cold of the night. Changes of temperature take place very slowly in the tree, but in the air they are rapid."

From this it follows that the influence of forests on the daily temperature is to make the nights warmer and the days cooler, in other words they communicate to the climate of countries clad with trees, an insular character.

And lastly, the large mass of water in the Mere, with its great specific heat and store of warmth, would thus have full power to exert its influence not only upon the air above and around it, but wherever this air is carried by the winds. In a former part of this memoir I have laid especial stress upon

the physical geography of this valley, and shown the suitability of the elevated land, forming its Eastern boundary (Oliver's Mount) for the site of an institution that may be established for the benefit of visitors suffering from consumption or other lung trouble.

The Atmospheric Pressure and Rainfall at Scarborough.—The tables which contain the details of the observations under these headings will be found in the Appendix, the results of which have been plotted on the diagram showing the sea and air temperatures.

The observations on the Atmospheric Pressure, with which I have been supplied, only extend over three years, 1879-81. The mean annual pressure was found to be 29·913 inches, which agrees with those records that place Scarborough on the isobar 29·9 inches. The higher we go North the nearer we approach those parts of the Northern Hemisphere where a minimum pressure is recorded all the year round, viz.: at 65° Lat. N., to this I have already referred in the section on the winds of Scarborough.

The great depression during *February* is to be remarked; the mean height of the mercury during this month being only 29·57. As atmospheric moisture is the great disturbing factor, and as we know that the moisture of the air at 65° Lat. N. is consistent with low readings on that parallel throughout the year, we may safely conclude that the February pressure at Scarborough is simply a representative of one of those isobars, which lie to the South of the Arctic depression, and are so persistent all the year within a small range of that parallel. This depression in February is coincident with great humidity of the air, although it is evident from the rainfall observations that this moisture is not precipitated to so great an extent as in other months. Atmospheric pressure, although it is one of the most important subjects to the meteorologist, and is the key to so many climatical phenomena, yet, as it is not under our control, and we are powerless to modify it, or protect ourselves against its constant changes, I shall not dwell longer on it, but proceed to give a few brief remarks on the rainfall, a subject which has already occupied our attention in the sections devoted to the Physical Geography of Scarborough, and the winds.

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The Rainfall at Scarborough. In Mr. G. J. Symons's* interesting and useful chart of the British Rainfall, with which the Rivers' Pollution Commissioners illustrated their Report, the district of Scarborough is so coloured as to represent an annual rainfall between 25 and 30 inches. The mean, as deduced from observations for the last 16 years, amounts to 29·64 inches: although during the last five years, it reached 31·67 inches.

February appears to have the least number of inches of rainfall recorded against it; viz: 1·74; but it must be remembered that during the first six months of the year, the lesser amount of rain falls, the proportion to that for the last six months, being as 11·29 to 18·35 inches. Now this rainfall, which is carried off and otherwise disposed of, has been already discussed, as well as its effect on the public health, and the local climate of Scarborough; which will obviate the necessity of saying more on this subject, than referring the reader to the Tables in the Appendix and the Diagram on the Map.

SECTION VII.

THE VITAL STATISTICS OF SCARBOROUGH: ITS LOW MORTALITY FROM CONSUMPTION (PHTHISIS). REMARKS AND RECOMMENDATIONS.

EVER since 1872, Dr. John W. Taylor, D.Sc., the Medical Officer of Health to the Urban Sanitary Authority of Scarborough, has issued in a printed form, ıually, Reports on the Sanitary Condition of this Borough; :h have year by year contained all that is required to be

*. G. J. Symons, F.R.S., is the great authority on "British Rainfall," and orks on this subject, will be read with interest; they are published ınford, Charing Cross.

known with regard to its vital statistics: it would therefore be, not only a waste of time, but an ungenerous act to attempt to supplement what this indefatigable Medical Officer has so well done in his excellent reports, with any remarks of my own, except to direct the attention of the Public to the interesting facts he has recorded, and to show how they bear upon the subject of this memoir.

General Health.—In the first place Dr. Taylor shows us in his reports for the last ten years, that the general health of Scarborough, as estimated by the Death Rate, from all causes has been remarkably good: for instance, the mean annual mortality to every *one thousand* persons living during the *ten* years 1873-82 only amounted to 18·4; of these nine years *three* had a mean of 20·1, *four* of 18·6, and *three* of 16·5, or in other words *seven* of the years had a mean of 17·7, to *three* of 20·1.

Let us now compare these figures with those of the Registrar General for the Urban and Rural districts of England during the ten years 1871-80. The *Urban* districts during this Decennial period had a mean annual mortality to every 1000 persons living of 23·1, and the Rural districts 18·5, so that Scarborough during the above period had a death rate of 4·7 persons less per 1000 than the urban districts of England, and a lower mortality than the healthiest rural districts. This saving of 4·7 lives to every 1000 annually, assumes vast importance when we consider that it takes place in a population of considerably over 30,000 inhabitants; for it means that, had Scarborough had the same death rate for the last ten years, as the mean of the other urban districts of England, the town would have lost on its mean population of twenty-eight thousand (28,450), *thirteen hundred and sixteen* persons more than it did: the money-value of such a life-saving, and its effect on the future prosperity of the town, will be duly appreciated by the statistician, and the political economist. The next question which I shall briefly discuss is, how these lives have been saved? In the first place it must be clearly understood that there are two grand causes always operating in every locality in either raising or depressing the rate of mortality: these are *Climate* and *Filth*. These two causes in some instances go hand in hand to destroy; the

mortality then is in excess; such an example may be found in those places, where social causes, such as filthy chamber, and alley air, filthy habits, filthy morals, and a filthy parentage, combine to lower the vitality of the inhabitants, and thus not only predispose them to certain diseases, such as Consumption, Rheumatism, Heart Disease, &c., but render them powerless to withstand the invasion of those that are contagious and infectious. In both cases climate might aggravate the initial evils: should such a population of depressed constitutions be exposed to the unchecked force of the prevailing winds, as they are in many parts of the worst districts of the North West of England, then those tainted with lung disease would fall easy victims to such a climate: again, should they be protected from such winds, in places where the air sewage of their valleys, streets and courts, are allowed to accumulate and stagnate, then do we find rheumatism, heart disease, and diseases of the contagious and infectious class intensified, and the death rate from these causes enormously increased, and more than counterbalancing any decrease in the mortality among the consumptive. Such cases are unfortunately far too common in England. On the other hand, our much abused climate exercises a most benign influence on many an inland town and village, and on many a seaside health resort. Often have I speculated upon the effect, on their death rate, of transporting some of the latter *inland*, where, deprived of the benign and counteracting influences of the sea winds, they would suffer from the deformities and filth of their "old towns," and the vicious arrangement of the streets, houses, and drains of their "new towns." The Sanitary arrangements of every place, whether it be a single house or a town, should be independent of *climate;* if it be not, greater fluctuation in the disease rate will ever be experienced than the most changeable of climates could produce.

In every health resort that has been engrafted on some old fishing village or sea port, there is necessarily an "old town," which, unless the "black spots," with which it generally abounds, are frankly acknowledged and grappled with by the Sanitary Authorities, is ever a source of anxiety to the Medical Officer of Health, and of danger to the health seeker. Some

of these "old towns," with all their "black spots," are studiously enclosed and shut out of view by the esplanades and terraces, and fine streets of the new: often on the principle of "out of sight out of mind," until the poor old town neglected and deserted, except by the poorest, with all the effects of its original faulty arrangement of houses, streets, alleys, drains, &c., intensified, by being shut out from the benefit of sea air flushing by the palatial buildings between it and the sea, resents the treatment that the authorities have allowed speculators to observe towards it, by every now and then suddenly and at unexpected and inopportune times, raising the death rate to such a height as to scare the unsuspecting visitors, lodging in grand hotels, or living in fashionable apartments between it and the sea: the effect of which is to set the tongues of the medical and general press loose, to cause a panic among health seekers, a stampede from the ill fated town, and a loss of reputation as a health resort; which means ruin to the trades people, the lodging house keepers, and the hotels: and a serious loss to all who are dependent upon the visitors for their livelihood.

All this might be avoided by following two rules: First, never to enclose an old town within the new, or raise lofty rows of buildings between it and the sea, or other prevailing winds, so as to exclude it from whatever air flushing its street arrangement may admit of. Second, never to lose sight of the defects of the old town; but to make a plan of what it should be, when it can be, and systematically improve the arrangement of its streets and sewers, until that plan is fully carried out.

Fortunately for Scarborough the evil I have just dwelt upon does not exist; the old is not shut in by the new town, and hence it enjoys all the advantages that its original site gave it.

Zymotic Diseases.—The low rate of mortality from what are called *Zymotic* Diseases is evidence that this class of causes of death does not thrive in Scarborough. I will subjoin the facts:—Dr. Taylor in his reports has shown that the mean annual death rate from these diseases, (which include Small Pox, Measles, Scarlet Fever, Diphtheria, Fever (Typhoid and others), Whooping Cough, and Diarrhœa), did not exceed during the ten years, 1873-1882, 1·6 to every 1000 persons living in Scarborough.

Now during the eleven years, 1870-1880, throughout England, the mean annual death rate from these causes amounted to no less than 4·2 to every 1000 living, so that had this borough had an average English death rate from these causes during the last nine years, there would have been an unnecessary loss of life to the extent of 2·6 persons to every 1000 of the mean population of 28,450; or in round numbers 728 lives lost, which might have been saved, and which in Scarborough were saved. Now when we reflect on the culpable thoughtlessness of visitors (a much stronger expression might be used in too many cases) who take either their infected selves and their belongings to health resorts, often furtively, it can never be wondered at, if, whilst these diseases exist elsewhere, they are brought to such places as Scarborough: no matter how well the Sanitary Authorities do their work, these diseases do get smuggled in, in a contraband fashion, and it requires all the vigilence and accumen of the Medical Officer of Health and the Inspector under him to avert the evil: that it has been dealt with successfully, however, in this borough, the above figures prove.

It is noteworthy that Scarborough contrasts favourably with the rural districts of the North Riding, with regard to these diseases: for instance, the mean annual death rate, from these diseases, in the *rural* districts of the North Riding during the three years, 1878-1880, amounted to 2·8 to every 1000 living, whereas for the same period, in this borough, the mortality was only 1·8. In 1882 the Zymotic death rate in the North Riding, excluding Scarborough, amounted to 2·3 per 1000, as compared with 1·6 in that Health Resort. Again, if we take Fever, including Typhoid, Typhus, &c., we find that whilst the mean annual death rate from these causes was ·45 in England, during the eight years 1873-1880, it was only ·25 in Scarborough during the ten years, 1873-1882. Scarlet Fever too, that bugbear to all Sanitary Authorities, in 1882, whilst it killed 108 person in the North Riding *outside* Scarborough, was the cause of only 4 deaths *within* that borough, or as ·12 to ·35 to every 1000 persons living. These figures are in themselves conclusive that so far as these grand causes of a high death rate are concerned, every effort is being made to reduce their power in this health resort.

Having seen how active and energetic measures have thus contributed to lessen the death rate from one set of causes, I will now conclude with some remarks on the effect of *climate* in the same direction.

The Low Mortality from Consumption (Phthisis) at Scarborough.—For the last thirty years, 1850-1879, four causes of death in England have maintained their position at the head of the Registrar General's list of 82 specified causes. The *first* on this list has stood Consumption (Phthisis); the *second* inflammation of the Bronchial tubes (Bronchitis); the *third* Convulsions; and the *fourth* inflammation of the Substance of the Lungs (Pneumonia).

Omitting the convulsive diseases, we have three diseases more or less influenced by *climate*, and their supreme mortality, it will be at once seen, must have an enormous influence on the general death rate. For instance, the mean annual death rates from these lung diseases, during the period, to every 1000 persons were as follows: from *Phthisis*, 2·4; *Bronchitis*, 1·7; *Pneumonia*, 1·1; total 5·2. Now during the same period the mean annual death rate from *all causes*, amounted to 22·1; exclude these more or less *climatic* diseases, and the annual death rate for England would have been reduced to 16·9: again, if we climinate those other diseases which are actually preventable—those of the zymotic class—we should get a further reduction to 12·7. I give these figures simply to show how *Climate* and *Filth* affect the death rate.

I will now analyze the death rate from Consumption (Phthisis) in Scarborough.

I have already given, in my introductory remarks on the geographical distribution of this cause of death in England and Wales, what I found in the Scarborough district relative to Phthisis, when I first initiated this enquiry in 1868.

In 1879 I visited Scarborough, and with the assistance of Dr. Taylor went thoroughly into the details of the statistics of Phthisis within the borough from 1872 the date of his appointment as Medical Officer of Health: on that occasion I found all that I had written on the Scarborough district fully realised, moreover, Dr. Taylor having year by year watched this disease himself, and reported what he had found, I was gratified to see my opinion thoroughly corroborated by

his figures. On that occasion I fully realised the position of the town, built as it is more than a hundred feet above the sea, on a site surrounded by precipitous cliffs. From the time of the publication of my large coloured map, in 1875, of the geographical distribution of Phthisis in England and Wales during the decennial period, 1851-1860, I have carefully noted each decennial since, and each year's statistics of this disease within the borough, so that I have thirty years records of the districts and ten of the borough before me, all telling the same uniform tale, and all confirming my original opinion as to the suitability of the climate of Scarborough for the *prevention of consumption.* Whilst in Scarborough, last year, I may add, through the kindness and courtesy of Mr. Read of the Superintendent-Registrar's Office, I went through the registers of the whole of the district of Scarborough and its sub-districts, and saw for myself the cause of every death that had taken place, within that area of more than 137 square miles, during the last eleven years, not only with the view of investigating the distribution of consumption, but that of other diseases as well.

From Dr. J. W. Taylor's careful statistics of Consumption, the following facts have been deduced.

First.—The mean annual death rate from this cause in the borough of Scarborough, for the last ten years, 1873-1882, amounted to 1·7 to every 1000 persons living of the *indigenous* population—I say *indigenous* because the population is estimated from the census returns, which are made from the enumerations taken every ten years, in April; a month in which few, if any, visitors are to be found in Scarborough—the death rates therefore calculated on the less population, are necessarily higher than they really are; for during several weeks in the year the town is crowded with visitors; yet the number of deaths which take place during the season are all proportioned to the estimated indigenous population. This should be corrected, and the first step in this direction was made last year, in the taking of the visitors census, the results of which Dr. Taylor has published in his Annual Report for 1882. It will be interesting to record these results:

Residents - - -	30,071
Visitors - - -	16,462
	46,533

Had the death rate from Consumption in Scarborough equalled the mean death rate for England, as stated above, viz.: 2·4 to every 1000 persons living, there would have died in this borough, during the last ten years, on an average of nearly 20 deaths annually (19·9) in excess of what really occurred from this disease, which in the period named would have amounted to more than 200 extra deaths (217). Thus did climate help to save 217 lives from this one cause alone.

With regard to the time of the year at which this disease is most prevalent, Dr. Taylor shows in his reports that the greater number of deaths take place generally during the first half of the year; but only to a very slight extent as the following figures will show:

Average for the first six months - - -	22·1	Deaths
„ „ last „ - - -	24·9	„
	47·0	

The mean temperature of the year (Ten years 1872-1881) - -	46·7°	Fahr.
The mean temperature of the first six months -	42·8°	„
„ „ „ last „ -	50·6°	„
Difference -	7·8°	„

In the former part of this section we saw how vigilance and determination had so far successfully contended against *Filth*, as to save in ten years 728 lives, among the population of Scarborough; we had also to place to the credit of *Climate* 217 more, making a total of 945, or nearly a thousand lives in ten years.

The death rate at Scarborough during the height of the Season, according to the *actual* population *living and sleeping* in the Borough, amounted, according to Dr. Taylor, to only 14·09 per 1000. Scarborough, however, as shown by this Report, suffers, along with other Northern resorts, a disadvantage (as compared with Southern watering-places) in calculating the death rate, as is usual, from the supposed per-

manent population. The census of the country generally is taken in April. This, as Dr. Taylor justly remarks, is a time when Scarborough is almost devoid of visitors, whilst the Southern resorts have an influx of them, in addition to their own permanent population, and as they *sleep* in these places on the night of the census, the population is of course abnormally *high*, whilst the death rate is vitiated, and made to appear abnormally *low*.

I have long been of opinion that censuses (especially in health resorts) should be more frequently taken. The continued study of the Geographical distribution of disease in the streets and alleys of our towns, daily convinces me that Sanitary Authorities should be constantly kept informed of the death rates of the streets, and certainly of all that form known "black spots,"—by pursuing such a system, as I have lately carried out, some remarkable revelations would be made.

I shall reserve all general remarks on what I have just shown, until my next and concluding section, when the general Sanitary condition of Scarborough will be considered: but before bringing this section to a close I wish to make some observations on two subjects connected with the climate of Scarborough in relation to the consumptive.

The Plantation of Trees.—In the first place I would remark, that, however peninsular the character of the climate of the borough may be, no means should be left untried that are calculated to render it as nearly *insular* as possible. Now it is well known that trees are powerful agents in bringing about this result; first because they have the power of storing heat, and second, because they prevent its radiation from the surface of the earth. I therefore have urged, on a former occasion, the planting of trees in large numbers wherever it is practicable. In the valley of the Mere, and on the sides of Weaponness Rigg (Oliver's Mount), the North Cliff, and Falsgrave Moor, I would suggest the planting of Pines and Firs, and in some selected spots the Sequoia Gigantea (Wellingtonia); it is a tree that in the Sierra Nevada has grown to gigantic proportions, and is now so well known in England as to obviate any further description. It is one of the Conifers and has been acclimatised

in Europe; for instance, it flourishes in Paris, but its *fruit* is destroyed by the cold of that locality. The *July* temperature of Paris is 65·2°, the *January* 37·0°, mean 51·1° In Dublin, Lat. N. 53° 13' 13", or only one degree to the South of Scarborough, where the July temperature is 61·0°, the January 39·0°, and the mean 50·0°, this tree has fruited freely in the Botanical Gardens of Trinity College, and healthy offspring from the seed has been produced at the seat of Lady Rolle, of Bicton, Exmouth. The July temperature at Scarborough is 60·1°, the January 38·6°, and mean 49·3°, so that there is only 0·9° less heat in July, and 0·4° in January in Scarborough than in Dublin, where the tree grows to perfection. The temperature of Scarborough is taken in a very exposed position, and I believe that when a regular series of observations, has been taken along the West side of Oliver's Mount, a higher mean temperature will be obtained. In Frimley, some trees planted 20 years ago are now of equal height, 10 feet in girth at the lowest branch, and 40 feet high. The finest avenue in Europe of these trees is Sir Gabriel Goldneys, near Bagshot; it is a mile long: they were planted 15 years ago. Why I have advocated trees of the pine and fir tribes being planted is because they not only carry out all the other objects of tree culture in improving climate, but their exhalations contain a large amount of *peroxide of hydrogen*, (often mistaken for ozone), a form of oxygen perculiarly grateful and healing to those affected with lung trouble.*

Hospital Accommodation. — In the North Riding of Yorkshire there is only one general Hospital, the one at Middlesborough; there are several Cottage Hospitals and other minor institutions scattered through the Riding, but these are evidently inadequate for the purposes of this part of Yorkshire; the result is that cases from Scarborough are sent to the York or Leeds Hospitals. Certainly Scarborough should have a County Hospital, and considering the aptitude of its climate for promoting the convalescence of the cases that would be sent to it, I would suggest that the most eligible site for such an institution would be about midway

*I would strongly recommend to all, who are interested in the culture or description of these trees, to read the beautifully illustrated and carefully written work, published by Messrs. James Veitch and Sons, King's Road, Chelsea, entitled, "*A Manual of Coniferæ*," price 7/6.

on the Western slope of Oliver's Mount; here all cases could be admitted, and those unfortunately suffering from consumption, as well as from accident or any other cause, would feel assured that they were in the best place possible for the amelioration or cure of their original diseases. Under any circumstances, Scarborough ought to have a General Hospital, if not a Convalescent Hospital, and another for Consumption.

SECTION VIII.

CONCLUSION: REMARKS ON THE GENERAL SANITARY CONDITION OF SCARBOROUGH, AND THE MEANS PROVIDED BY THE SANITARY AUTHORITY FOR THE HEALTH AND RECREATION OF THE INHABITANTS AND THEIR VISITORS.

ALL who leave their homes in search of change of air, either for health sake or relaxation, have generally anxieties enough, inherent to the change, without having them multiplied by fears lest the resort which they have selected may bring upon them evils that they know not of: my own experience, as well as that of many a medical officer of health, tells us how, during the seaside season, diseases of the infectious and contagious kind are brought by families from what are called health-resorts to inland homes, there to mature and bear fatal fruit, where hitherto they had been unknown. The histories of these cases are always lamentable, and in most instances reveal culpable neglect either on the part of the Sanitary Authorites of the resort were the diseases were contracted, or on that of the hotel and lodging-house keepers, where the victims took up their temporary abode. At the same time it must be conceded that all places are at times subject to the furtive invasion of disease, however on

the alert may be the Sanitary Authorities and their officers; but it has been found that the disastrous consequences of such invasions are as a rule successfully averted in the direct ratio of the perfection of the sanitary regulations adopted; for it must be remembered that wherever a good system of sanitation is pursued, resolutely acted upon, and intelligibly explained by candid reports, showing the good results of obedience to it, and the amount of loss in health, life, and money when opposed or disobeyed, the most intelligent and interested part of the community, among whom such a system is adopted, in time become educated in health matters; see the necessity of putting their own houses in order, and of helping the authorities in their raid on the "black spots" of their town. Wherever such a happy combination of forces against the common enemy, disease, obtains, there the greatest amount of security prevails, and there will the visitors enjoy their change without anxiety, and without fear of possible evil.

I will now briefly describe some of the principal means provided by the Sanitary Authority of Scarborough, acting under the advice of the Medical Officer of Health, Dr John W. Taylor, for securing the health of the inhabitants and their visitors.

1.—*House Inspection, and Certificate System.*—To Dr. Taylor belongs the credit for initiating and carrying out this admirable system, which consists in the thorough inspection of all Hotels, Lodging and other houses, by permission of the occupiers. The Inspector visits and inspects all the houses he possibly can, noting at the time any sanitary defects; the drains are tested, their ventilation examined; causes of dampness and effluvia discovered; inquiries as to recent illnesses, etc., made; the water supply tested, if necessary, and when cisterns are used, their relation to any possible source of pollution inquired into; in fact a thorough investigation of each house is made. A report is then drawn up and entered in a Sanitary Register kept at the Town Hall. The defects and their remedies are pointed out to the occupier, and as soon as all the recommendations are carried out, the house is revisited by the Inspector, and if he be satisfied with the work done, he recommends the Sanitary

Authority to grant a *Certificate* to the effect that the house in question is, as far as can be ascertained, in a good sanitary condition. Whenever a preventible disease breaks out in any house reference is immediately made to the register to ascertain whether the house has a certificate or not, and whether the recommendations for its sanitary improvements have been attended to. The system works admirably, and the people are thankful for so much interest being taken in their sanitary comfort and security. Would that the authorities of other health resorts followed the excellent example set by Dr. Taylor and the Corporation of Scarborough.

Under such a system the visitors are to blame if they do not, before engaging apartments, whether in hotels or lodging-houses, satisfy themselves that the house is certificated; they should remember, too, that those who hold certificates are only too glad to show them; besides which, the Sanitary Register is always open for reference at the Town Hall, where visitors can see for themselves the list of certificated houses.

The medical practitioners in Scarborough all act in harmony with the medical officer of health; and hence another safeguard is added, for this hearty co-operation with the responsible officer of the Sanitary Authority results in the immediate notification of the existence of infectious and contagious diseases, and thus obviates much of the evil resulting from the absence of the compulsory powers to enforce it.

Whilst on the subject of Lodging-houses, I wish to note a system among the proprietors of these houses, that acts injuriously in the early months of the spring and summer. We have seen the effect of elevated masses on the postponement of the summer and winter seasons, viz.: that the warmth of the *summer* is prolonged in them until late autumn and the early winter, and that the cold of the *winter* is similarly postponed until early spring. Now I know from experience at Scarborough and elsewhere, that many lodging-house keepers either leave their houses altogether during the winter, or else inhabit a small portion of them on the ground floor: the effect of this system is to allow the winter *cold* thoroughly to penetrate the walls, floors,

and every article of furniture in them, and thus so thoroughly to chill the houses, that when the early visitors begin to occupy them they have reason to complain of the cold over which the fires, however good, seem to have no power; they say, truly, that they "feel warmer out of doors than within," and the disagreeable consequences, such as colds, coughs, and rheumatism are attributed to the climate instead of the right cause.

Lodging-house keepers should remember that their customers come at that time of the year from their well warmed houses inland, and the contrast between them and miserably cold strange apartments gives an unfavourable impression, which in many instances affects the health of the visitor and indirectly the reputation of the health resorts: first impressions are very lasting.

Now to obviate this evil I would recommend the proprietors of lodging-houses never to leave their houses unoccupied, and if they do not live in them themselves during the winter, to employ somebody to do so, whose duty shall be to attend to the fires and gas during the empty season. I believe that in the majority of some of the best houses a couple of tons of coal, with gas kept burning in the hall and staircases would effectually keep the *frost* out of the houses even during the severest winters. Fires need not be kept up in every room at the same time, but every room in the house should have a good fire kept in it in turn, *and every room that has no fire place in it should be condemned as "unfit for human habitation" and noted so on the Sanitary Authority's Certificate.*

Water Supply.—In the excellent and valuable work of Mr. C. E. De Rance, entitled "The Water Supply of England and Wales,"* the water supply of Scarborough is thus mentioned: "From springs at the foot of the cliffs in Cayton Bay and from a well at Cayton, both 3¾ miles south of Scarborough; by reservoirs, to which the water is raised by pumping. Maximum quantity used daily, between 800,000 and 900,000 gallons *-constant.* Rateable value, £135,695 11s. 8d. 8 and 9 Vict., cap. 68 (1845). The Scarborough Water Works Amendment Acts, (1856-1863). *The Corporation of Scarborough has purchased the undertaking under an*

* Stanford, London, 1881, p. 66.

Act, and powers were given for the transfer on 1st October, 1878. Rainfall at Osgodby in 1879, at 262 feet above the sea, 28·31 inches."

The italics are mine, as I wish to emphasise the fact, for it is an example that should be followed by all Corporate bodies, to whom the health and the prosperity of the people are committed. One of the consequences of this wise step is that an abundant supply of water is bestowed at Scarborough in the flushing of the tributary drains of the main sewers, which, the Surveyor, Mr. Joseph Petch, tells me is regularly effected in all the streets, alleys, and small courts of the old town, under his superintendence—so that the system of flushing with large volumes of water is not left to be carried out by the occupiers of houses.

I have known too many instances of authorities pluming themselves on the amount of water they every now and then send down the *main* sewers—a most useless and wasteful system, for unless every drain that leads to the main is first flushed with an adequate volume of water the evil still remains. We should remember that drains are like the blood vessels in the animal body : obstruction and congestion first take place in the smallest members of the system; relieve them of these and the main vessels will be ready to carry off the peccant causes,—so with drains, the smaller the drain the greater the danger of accumulation of sewage, its decomposition, and the dissemination of its gases and animal poisons into houses and streets, where the obstruction takes place.

The Corporation are constructing another fine reservoir on the summit of Oliver's Mount, 500 feet above the sea, which will be of incalculable advantage.

The water is of the finest quality,—the well at Cayton is about half way between Osgodby Hall and the village of Cayton. The mouth of the well is 159·6 feet above the sea level, and the shaft is sunk 137 feet below, to the Oxford Clays, through the Limestones and Calcareous Sandstones of the Coralline Series of the Middle Oolite, and thence through the Lower Calcareous Grit to the Oxford Clay.

Removal of Filth.—Whilst these pages are going through the press I have an opportunity of showing how "Filth" is

disposed of in this Borough. The Annual Report of the Medical Officer of Health for 1882, embodies an exceedingly good one from the Sanitary Inspector, Mr. Finlay, who has not only earned for himself the Certificate of the Sanitary Institute of Great Britain, but the approbation of all who are associated with him in the Sanitary work of Scarborough, by his intelligence, his thorough knowledge of his duties, and the conciliatory, but firm manner in which he performs them. Mr. Finlay reports as follows as to the disposal of some of the filth :

"*Removal of House Refuse.*—The number of Ash-pits and "Ash-closets now in the Borough is estimated at 8,000, from "which, during the year (1882) 12,064 loads of refuse were "removed by the Authority, and disposed of *by sending it to* "*the farmers* in the neighbourhood. As the Committee will "be aware, refuse is removed *once a week,* necessitating no "less than *416,000 visits being made during the year,* in "addition to which, there are also several places which must be "attended to every day, such as fish shops, large hotels, &c."

"*Street Cleansing and Watering.*—The work of cleansing "the town during the year (1882) has been efficiently per- "formed, no less than 9,360 loads of street sweepings were "removed, and 12,510 loads—equal to about *two and a half* "*million gallons*—of water used during the *summer months* "for *street watering.*" To the authorities of many so called health resorts I would say "go and do likewise."

The Old Town.—As I have said before, an old town is always a source of anxiety, but as the recognition of "black spots" has always been a salient feature in Dr. J. W. Taylor's sanitary policy, the result is that, with the co-operation of the Town Surveyor, Mr. Joseph Petch, he has succeeded in remedying the worst of its evils, and in reducing to a minimum the dangers inherent to narrow streets, alleys, and courts, by asphalting, draining, and flushing them ; and I can speak from personal experience that during the three months I resided in the town I seldom passed a day without going through some of the oldest streets and alleys, and I can truly say I was never once annoyed by offensive effluvia of any kind. The asphalting and paving the narrowest streets, as well as the larger and more important thoroughfares, materially conduce to their dryness, and to the dryness of the

houses which skirt them. This freedom from moisture, and the quick drying, after rain, of the surface, strikes every visitor to Scarborough, and materially adds to their comfort and health.

The old town is well situated as regards aspect, which is almost due South, and the streets are generally so arranged as to admit of air flushing from the winds coming from the sea, the sloping character of the site facilitating this ventilation, as the streets from the sands to the Castle Road Ridge gradually rise one above another, and are thus enabled to receive the fresh sea breezes instead of being shut out from them: this is of immense advantage, and doubtless has been an important factor in the healthiness of this the oldest part of the town.

The old town may be said to be comprised within the area to the East of the site of the Old Moat, that once extended from the North Cliff across where Blenheim Terrace now stands, along the West of Blenheim Street to Castle Road, then to the South East of the Mariners' Asylum, between North Terrace and Castle Road to where the Old Borough Gaol once stood, (now the site of the New Town Hall), thence around St. Thomas' Walk, crossing North Street and Hill Road, to the North East end of Aberdeen Terrace, crossing the site of the Bull Hotel, and Westborough to the West of the Bar, (which I am glad to think is doomed, for it is not only a vexatious obstruction to the traffic, but to the free ventilation of Newborough and Eastborough). From the Bar it took its course between Bar Street and Huntriss Row, crossing Falconer Road and ending on St. Nicholas Cliff.

On looking over an old map of the town one is struck with the care with which each well and draw-well is noted; fortunately these archaic institutions' occupation is gone and the abundant water from Cayton has taken their place.

The Drainage.—Scarborough is well drained; from Mr. Petch's report in 1881, it appears that during that year he completed 1974 yards of main sewers, making a total length of drains equal to 27 miles and 310 yards: during, however, the year 1882, the amount of *new* drainage was very nearly doubled, as it equalled 3,828 yards, or 2 miles and 308 yards of main sewers, so that up to the end of that year there was a total length of 29 miles and 618 yards.

Shaft ventilation of the Sewers is the system adopted in preference to open gratings in the streets. Mr. Petch, who showed me a large number of the shafts, is most energetic in erecting them wherever he has an opportunity, and each year his report contains an increasing number. In fact, these ventilating shafts are thickly scattered all over the town, consequently there is an enormous number of them; and the system works admirably: it would be well if other towns followed the same plan instead of their authorities worrying themselves to prove that malarious gases from street gratings are harmless. Open gratings, however, without any deluding traps, are advantageous, rather than otherwise, where the sewers and the tributary drains are abundantly flushed, and thus kept clean; for they not only promote ventilation, but give immediate warning of sewage accumulation, and consequent obstruction to its free flow: the chief causes of sewage putrefaction and the disengagement of stinking gases, and their odourless and invisible concomitant animal poisons. There is no danger in a *clean open* sewer, but the greatest in a *covered foul* one.

House Drainage. Dr. Taylor has made his own residence a model of what the drainage of every house should be, and the sooner his neighbours follow his example the better. It would be well if the Sanitary Authorities made it compulsory that all new houses should have their drains similarly arranged. No house should either stand on a drain or have one within its walls; and all communications with the sewers should be cut off in the mode that Dr. Taylor has adopted, which enables the occupier at all times to examine the drains.

Whenever a sewer or drain is laid down, an ordinary subsoil drain pipe should accompany it for the purpose of carrying off redundant moisture from the soil, the two systems, however, should never communicate, the water drains may be carried in any direction, according to the slope of the ground. I would also advise, whenever the ground is opened, whether for laying a drain, building the foundation of a house, or any other reason, that an accurate section be at once made of the part cut through, and the depth, in inches, recorded of the different kinds of soils such as gravel, sand, rock, etc., met with. These sections should be colored geo-

logically and properly recorded. This system was thoughtfully conceived and well carried out by Mr. Philip C. Lockwood, the Borough Surveyor of Brighton, when that town was first drained. The coloured sections, carefully made by Mr. Rocksborough Smith, Chief Draughtsman to the Corporation, were kindly placed at my disposal and enabled me to construct the Physical and Geological Map of Brighton, which was published last year.* It would be well to collect as many sections of wells, and other shafts, that are still in existence: they are always useful and eventually, with other information, will assist in mapping the different drift, gravels, sands, etc., which lie above the Upper Estuarine series of rocks, on which the town stands.

The outfall of the main sewer is always a source of trouble at sea-side watering places; but when the present one is done away with at the harbour, and the main sewer is continued beyond Scalby Ness, there will be an end of any possible contamination of the waters of the two bays from sewage. I have daily watched the effect of heavy rains on these bays, and am convinced that all sewage must be taken to the point indicated.

I have now little more to add, except to express a hope that the contemplated new drive from Peasholm to White Nab, around the Castle Cliff, will soon be commenced and completed, for then will Scarborough have the grandest promenade and carriage drive in the world. The North Cliff must be planted and beautified with trees, and every inducement held out to the Visitor to test the value of this delightful part of the town, where one of the most perfectly bracing and tonic climates in England can be enjoyed.

The Recreations that have been provided for the Visitors are all well set forth in the "Theakston's Scarborough Guide," and other works of a similar kind, that I need not dwell upon them here. In Messrs. Theakston's most excellent and interesting guide, there is an elaborate list of plants found in the neighbourhood of Scarborough; the flowering season and haunts of each are indicated, besides a large amount of information relative to the geology and general natural history of the district. The Chalybeate and Saline springs at the

* "The Health Guide Map of Brighton," Beal & Co., Brighton, 1882.

Spa are too well known to require any comment. The Museum, with its many archeological and natural history treasures, will ever be a source of improvement and recreation to the visitor; and the Aquarium, which I believe is one of the largest in the world, is always a source of attraction. But the great recreation, however, is the beauty of the town itself, with its Castle Cliff surmounted by the ruins of the Keep; the Ramsdale with its Valley Bridge; and a host of other rambles within and outside the town, which are never failing attractions to the visitor.

A good general Reference Library, however, is much wanted, where, on rainy days, the visitor could recreate himself with the pursuit of studies most congenial to his taste. This should be in connection with the Museum, if possible, where there is already a good nucleus of a library, the use of which, through the kindness of Mr. J. H. Phillips, the Hon. Secretary of the Scarborough Philosophical and Archæological Society, I much enjoyed during my visit.

I must now conclude what I have at present to say of Scarborough, and sincerely hope that the facts I have endeavoured to bring before the notice of the public will be sufficient to prove that this delightful watering place has a firm foundation for its eminence as a Health Resort, and that its own peculiar and splendid climate, combined with wise Sanitary Regulations, will enable it not only to preserve its far famed reputation, but to spread it still further, to the advantage of all who may resort to it in summer, autumn, or winter, either for the prevention of disease, or restoration to health.

THE END.

APPENDIX A.

TABLE I. *THE WINDS.*

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
Jan.									
1877	1	1	2	1	9	5	9	2	0
1878	5	3	0	0	2	5	13	3	0
1879	2	2	8	4	4	0	6	4	1
1880	3	0	1	1	4	8	10	4	0
1881	0	3	3	2	2	6	9	6	0
	11	9	14	8	21	24	47	19	1
Feb.									
1877	7	0	0	0	0	4	13	4	0
1878	3	0	1	0	5	7	10	2	0
1879	4	3	6	1	6	4	4	0	0
1880	1	0	1	0	8	5	13	1	0
1881	5	2	3	2	7	1	7	1	0
	20	5	11	3	26	21	47	8	0
Mar.									
1877	4	2	4	2	3	2	10	4	0
1878	10	3	1	0	0	3	6	8	0
1879	2	2	7	2	1	4	10	3	0
1880	2	3	8	5	4	1	8	0	0
1881	4	1	0	2	6	3	12	3	0
	22	11	20	11	14	13	46	18	0
April.									
1877	3	3	10	7	5	0	1	1	0
1878	4	2	9	6	4	1	4	0	0
1879	7	7	7	2	4	1	2	0	0
1880	8	2	6	0	5	3	6	0	0
1881	5	6	9	3	3	0	3	1	0
	27	20	41	18	21	5	16	2	0
May.									
1877	9	7	5	1	4	3	2	0	0
1878	3	0	5	6	6	4	7	0	0
1879	12	1	3	1	6	2	5	1	0
1880	11	4	2	1	4	1	5	3	0
1881	7	1	5	0	3	5	8	2	0
	42	13	20	9	23	15	27	6	0
June.									
1877	2	4	6	3	4	5	6	0	0
1878	4	0	3	8	8	2	1	4	0
1879	1	1	4	1	7	6	7	3	0
1880	14	1	3	1	1	2	7	1	0
1881	7	1	1	1	4	8	5	3	0
	28	7	17	14	24	23	26	11	0

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.
July.									
1877	0	0	0	2	4	5	18	2	0
1878	12	3	4	3	3	0	5	1	0
1879	7	2	1	4	4	1	12	0	0
1880	5	1	7	2	2	1	13	0	0
1881	5	0	0	0	0	6	17	3	0
	29	6	12	11	13	13	65	6	0
Aug.									
1877	6	2	1	4	5	2	9	2	0
1878	2	4	8	4	4	5	3	1	0
1879	4	0	3	2	7	9	6	0	0
1880	13	5	7	0	2	1	1	2	0
1881	3	0	1	1	6	4	15	1	0
	28	11	20	11	24	21	34	6	0
Sept.									
1877	12	3	3	0	2	1	7	1	1
1878	6	0	2	1	7	2	12	0	0
1879	5	0	0	3	5	7	8	2	0
1880	4	0	2	2	2	3	14	3	0
1881	11	2	2	1	5	2	6	1	0
	38	5	9	7	21	15	47	7	1
Oct.									
1877	3	0	0	2	6	6	12	2	0
1878	2	0	0	4	10	3	8	4	0
1879	5	0	4	0	1	3	12	6	0
1880	6	2	10	0	0	1	9	3	0
1881	2	1	14	2	1	2	8	1	0
	18	3	28	8	18	15	49	16	0
Nov.									
1877	0	0	1	0	8	10	9	2	0
1878	11	4	1	0	0	3	8	3	0
1879	9	2	5	0	0	1	8	5	0
1880	2	2	3	0	3	5	11	4	0
1831	0	0	0	0	10	9	11	0	0
	22	8	10	0	21	28	47	14	0
Dec.									
1877	1	1	2	0	3	7	11	5	1
1878	6	0	1	0	0	4	12	8	0
1879	2	0	3	1	3	5	15	2	0
1880	1	1	0	0	4	4	17	4	0
1881	1	1	0	1	7	9	10	2	0
	11	3	6	2	17	29	65	21	1

APPENDIX A.

TABLE II. *THE WINDS.*

DIRECTION OF WIND AT SCARBOROUGH, DURING 5 YEARS 1877—1881 INCLUSIVE.

	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Calm.	
December	11	3	6	2	17	29	65	21	1	Winter.
January	11	9	14	8	21	24	47	19	1	
February	20	5	11	3	26	21	47	8	0	
Total for Winter	42	17	31	13	64	74	159	48	2	
March	22	11	20	11	14	13	46	18	0	Spring.
April	27	20	41	18	21	5	16	2	0	
May	42	13	20	9	23	15	27	6	0	
Total for Spring	91	44	81	38	58	33	89	26	0	
June	28	7	17	14	24	23	26	11	0	Summer.
July	29	6	12	11	13	13	65	6	0	
August	28	11	20	11	24	21	34	6	0	
Total for Summer	85	24	49	36	61	57	125	23	0	
September	38	5	9	7	21	15	47	7	1	Autumn.
October	18	3	28	8	18	15	49	16	0	
November	22	8	10	0	21	28	47	14	0	
Total for Autumn	78	16	47	15	60	58	143	37	1	
5 Years	296	101	208	102	243	222	516	134	3	

APPENDIX A.

TABLE III. *TEMPERATURE.*

ABSOLUTE MAXIMUM AND MINIMUM FOR EACH MONTH.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.	
	Max. °	Min. °	Max. °	Min. °	Max. °	Min. °	Max. °	Min. °	Max. °	Min. °	Max. °	Min. °
1877	56·5	31·5	53·2	24·5	52·0	25·7	51·8	34·7	62·2	32·9	74·7	45·7
1878	55·0	26·9	55·7	30·8	58·4	29·1	64·1	28·2	66·0	35·9	74·6	43·7
1879	43·0	26·9	49·7	28·3	56·1	28·8	55·7	31·0	63·3	34·0	68·5	41·9
1880	54·3	23·7	53·4	32·7	58·3	28·5	64·3	35·5	67·3	37.9	70·3	39·7
1881	44·8	10·5	49·5	29·8	60·8	22·4	60·8	31·3	71·3	33.5	71·1	40·5
	JULY.		AUGUST.		SEPTEMBER		OCTOBER.		NOVEMBER.		DECEMBER.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
1877	73·3	46·8	69·0	45·0	63·2	41·0	63·4	31·0	57·2	33·0	51·3	26·0
1878	81·3	46·0	70·7	51·8	70·5	41·9	63·9	32·0	48·5	27·9	50·7	17·0
1879	74·1	48·4	68·3	46·0	68·1	42·0	61·3	38·5	54·3	27·5	54·3	19·5
1880	72·2	48 7	76·3	50·5	74·8	44·0	61·3	33·4	58·3	27·3	54·0	28·5
1881	80·6	47·3	81·0	45·0	68·3	44·5	60·8	33·5	61·1	33·5	49·4	29·0

TABLE IV. *TEMPERATURE.*

MONTHLY MEANS OF MAX. AND MIN. AT SCARBOROUGH.

MONTHS.	1877.		1878.		1879.		1880.		1881.		Mean Temp. 14 years 1861 to 1881.
	Mean of Min. °	Mean of Max. °	Mean of Min. °	Mean of Max. °	Mean of Min. °	Mean of Max. °	Mean of Min. °	Mean of Max. °	Mean of Min. °	Mean of Max. °	°
January ...	37·2	44·9	36·8	43·9	32·1	36·8	33·3	40·4	28·6	35·7	38·0
February ...	36·8	46·9	37·7	46·2	33·7	38·8	38·3	46·3	34·3	39·4	39·8
March	34·8	44·0	38·0	47·1	35·5	44·4	38·0	46·0	34·9	45·9	41·3
April	39·6	45·6	41·0	49·7	37·9	44·5	41·3	51·7	37·9	47·6	42·3
May	42·3	51·1	46·4	57·4	41·4	51·7	43·6	54·6	44·7	58·4	49·9
June	50·6	63·2	51·1	61·5	49·0	61·2	49·7	59·3	50·0	62·0	55·8
July	53·9	65·6	55·9	65·7	51·7	60·6	53·6	63·2	54·5	68·3	60·2
August	53·0	61·9	55·7	64·4	52·2	62·8	56·3	64·7	51·2	62·6	58·7
September	48·6	56·6	51·3	60·5	48·8	58·2	53·2	63·2	50·5	58·8	54·9
October ...	44·3	53·3	47·0	54·9	44·0	53·5	42·8	50·8	42·6	50·2	48·5
November..	40·2	48·7	36·7	43·8	37·6	45·2	38·2	47·7	42·7	51·5	42·7
December...	36·6	43·9	28·8	37·6	30·9	39·7	36·7	44·6	35·9	43·4	38·8
	43·1	52·1	43·8	52·7	41·2	49·8	43·7	52·7	42·3	51·9	47.6
	47·6		48·2		45·5		48·2		47·2		
Mean for 5 years	47·3°										
Mean for 14 years	47·6°										

APPENDIX A.

TABLE V. TABLE VI.

RAINFALL AT SCARBOROUGH.								SEA TEMPERATURE.
Months.	1877. Inches.	1878. Inches.	1879. Inches.	1880. Inches.	1881. Inches.	Average 5 Years 1877-1881.	Average 16 Years 1866-1881.	Average 5 Years 1877-1881.
January	3·42	2 51	1·18	0·34	1·38	1.76	1·87	41·2
February.....	2·04	0·68	3·19	1·62	3·13	2·13	1·74	40·4
March	1 98	1·54	0·96	1·89	2 94	1·86	1.83	41·5
April	3·26	2·37	1·89	2·36	0·76	2·12	1·82	42·7
May.....	1·64	2·72	3·74	2·28	1·17	2.31	1·94	46·3
June.....	1·40	3·53	2·89	2·43	1·26	2·30	2·09	50·3
July.....	2·44	0·32	4·00	4·89	3 29	2.98	2·82	53·2
August	4·36	5·73	2·78	1.96	7·53	4.47	2·78	54·6
September ..	4·35	1·32	1·87	3·50	4·95	3·19	3·17	54·1
October	1·98	2·57	1·10	6·12	3.98	3·15	3·16	51·4
November ...	1·81	5·06	3·26	2·31	1·81	2·85	3·16	47·2
December ...	2.32	3·86	1·34	2.85	2·40	2·55	3.26	43·7
TOTALS ...	31·00	32·21	28·20	32·55	34·60	31·67	29 61	47·2

APPENDIX A.

TABLE VII.

READINGS OF THE BAROMETER AT SCARBOROUGH DURING 1879, 1880, 1881.

MEAN OF EACH MONTH.

MONTHS.	1879	1880	1881.	MEANS.
	Inches.	Inches.	Inches.	Inches.
January	30·050	30·320	29·917	30·095
February	29.522	29·690	29·505	29·572
March	29·956	30·110	29·842	29·969
April	29 724	29·827	30·015	29·855
May	30·002	30·097	30·068	30·055
June	29·742	29·914	29·931	29·862
July	29·711	29 846	29·916	29·824
August	29·757	30·034	29·750	29·847
September	29 915	29·927	29·997	29 946
October	30·083	29·907	30 025	30·005
November	30·192	29·848	29·810	29·950
December	30·254	29·809	29 884	29 982
Means	29·909	29·944	29·888	29 913

Mean of 3 years - 29·913.

Observe that the Barometer is *lowest* in February, which is the *driest* month in the year. (Signed) W. C. HUGHES.

APPENDIX B.

THE following table is given in order to facilitate the acquirement by the visitor of some knowledge of the physical features of the surrounding neighbourhood of Scarborough, which not only contribute so much to its beauty, but exercise so powerful an influence on the climate of the borough. Besides the works of Phillips, Huddleston, Williamson, and others, which will be found in the Museum, the reader should provide himself with the coloured one-inch map of the Geological survey for this area, if not with the more distinct and satisfactory six-inch maps: the memoir by Mr. C. Fox Strangways, F.G.S., will assist for the district South of Scarborough. It is not within the scope of this work to treat more elaborately than has already been done the geology of Scarborough.

The reader must remember that many of the inland formations within two or three miles of the coast line are masked by the Northern or glacial drift consisting in some parts of boulder clay, gravels, and sands.* In the following table the formations are given from the summits in their natural order downwards; the lower series being generally found forming the bottoms and sides of the valleys and water courses. The direction in which the different heights lie in relation to the town is supposed to be from its centre, but the table can be used either from the Castle Hill or Oliver's Mount, provided a compass be used and the slight correction made, which the distances of these two standpoints from the central spot necessitate. Nobody but those who have studied *Climate* in relation to Physical Geography can fully realize how much light is thus thrown upon this subject, without studying the configuration of a country from elevated positions. Merely, however, to know the names of heights, without learning all that is possible about them is of very little use, and soon

* For interesting accounts of these purple boulder clays, gravels, and sands, see "The Great Ice Age" by James Geikie, LL.D., F.R.S., p. 383, and Phillip's *Quart. Journ. Geol. Soc.*, Vol. xxiv., p. 254: *Geology of Yorkshire.*

ceases to interest. The Derwent country is a beautiful one indeed, and full of interest to all who are students in landscape drawing, geology, physical geography, and many other pursuits in natural history ; pursuits that often lend their potent aids to the medical man in his treatment of disease.

Explanation of the abbreviations of the terms used to describe "The Geological Formations" in the following table—

SUPERFICIAL DEPOSITS.
P.—Peat
W. & L.C.—Warp and Lacustime Clay.
S. & G.—Sand and Gravel.
D.—Drift—Boulder Clay and Gravel.

UPPER CRETACEOUS.
W.C.—White Chalk.
R.C.—Red Chalk.

LOWER CRETACEOUS.
N.C.—Neocomian Clay.

UPPER OOLITES.
K.C.—Kimeridge Clay.

MIDDLE OOLITES.
U.C.G.—Upper Calcareous Grit.
U.L.—Upper Limestone.
M C.G.—Middle Calcareous Grit.
L.L.—Lower Limestone.
C.O.—Coralline Oolite Limestone.
P.B.—Passage Beds, "Greystone."
L.C.G.—Lower Calcareous Grit.
O.C.—Oxford Clay.
K.R.—Kellaway Rock.

LOWER OOLITE.
C.—Cornbrash.
U.E.S.—Upper Estuarine Series.
M.C.—Moor Grit or Moor Stone.
S.L.S.—Scarborough or Grey Limestone, "*Pier Stone.*"
M.E.S,—Middle Estuarine Series.
M.S.—Millepore Series.
L.E.S.—Lower Estuarine Series.
Q.—Quarry Worked.

The above are in accordance with the nomenclature used by Mr. C. Fox-Strangways, F.G.S., in his memoir on the "Geology of the Oolitic and Cretacious Rocks South of Scarborough." 1886. London.

APPENDIX B.

TABLE OF HEIGHTS, DISTANCES, AND GEOLOGICAL FORMATIONS.

Direction.	Names of Heights and other natural features	Dist'ces in miles.	Heights in feet.	Geological formations.
Between				
N. by W. & N.N.W.	Old Peak	9½	872	m.g., S.L.S., M.E.S.
	Hills between Hayburn Wyke and Cloughton Newlands	4½	426	m.g., S.L.S., M.E.S., Q.
N.N.W. & N. W. by N.	Stoney Marl Howe	9½	775	U.E.S., m.g., S.L.S., Q.
	Pie Rigg Howe	8¼	800	U.E.S., m g.. S.L.S., P.
	Staintondale Moor	7	600	M.E.S., M.S.
	Brown Rigg	6¾	700	m.g.,S.L.S.,f.,.ME S.,M.S
	Cloughton Moor	5¼	612	m g.,S.L.S.,M.E.S., M.S.
N. W. by N. & N.W.	Low Moor	12¼	700	U.E.S , m.g., S.L.S.
	John Cross Moor	12	770	U.E.S., m.g., S.L S.
	Part of Fylingdales Moor	9¼	684	U.E.S., m.g., S.L.S.
	Jugger Howe heights	8½	675	U.E.S , m.g., S.L.S.
	Harwooddale Moor	7¾	627	U.E.S., m.g., S.L.S.
N.W. & N.W. by W.	Burn Howe Rigg	10¾	978	U.E.S.
	John Cross Howe & Rigg	11	769	U.E.S.
	Lownorth Moor	8¼	627	U.E.S.
	Harwooddale Moor	8½	600	U.E.S.
	Hackness Moor	6¼	600	L.C.G., O.C., K.R., C., U.E.S.
	Suffield Moor	4¾	625	L.C.G., O.C., K.R., C., U.E.S.
N. W. by W. & W.N.W.	Derwent Head Rigg	10¼	952	U.E.S.
	Wykeham High Moor	9½	669	K.R., C., U.E.S.
	High Langdale Rigg	7⅛	802	L.C.G., O.C., K.R., C., U.E.S.
	Silpho	5¼	650	U.C.G., U.L., M.C.G., C.O.,P.B.,L.C.G.,O.C., K.R., C., U.E.S.
	Scalby Nabs	3¼	500	L C.G., O.C., K.R , C., U.E.S.
W N.W. & W. by N.	Allerston High Moors	11	800	K.R., C., U.E.S ,
	Blakey Moor	10½	600	O.C., K.R., C , U.E S.
	Ebberston High Moors	8¾	603	K.R., C., U.E.S.
	Saltersgate Moor and Nab	11¼	800	K.R., C., P., U.E.S.
	Blakey Moor & Topping	10⅝	873	L.C.G., O.C., K.R , C.
	Howden Hill	6¾	456	L.C.G., O C., K R., C.
	Bickley Nab	8	800	L.C.G., O.C., K.R., C.
	Suffield Heights	4¾	500	L.L., (co) Q , P.B., L.C.G., O.C., K.R , C.

Direction.	Names of Heights and other natural features	Dist'ces in miles.	Heights in feet.	Geological formations.
Between				
W. by N. & W.	Allerston Low Moor	9⅓	600	K.R., C., P., U.E.S.
	High Dalby	10	790	M.C.G., L.L., P.B., L.C.G., O.C.,
	Troutsdale Moor	7¼	768	M.C.G., L.L., P.B., L.C.G., O.C.
	Backleys	7	726	P.B., L.C.G., O.C., K.R., C.
	Coombe Hill, Wrench Green	6⅓	643	L.C.G., O.C., K.R., C.
	Shortgate Wood Hill	5¾	600	L.C.G., O.C., K.R., C., U.E.S.
	Hawthorn Wood Hill	4½	525	P.B., L.C.G., O.C., K.R., C., U.E.S.
	Seamer Moor	3⅓	600	L.C.G., O.C., K.R., C., U.E.S.
W. & W. by S.	Low Dalby	10½	600	M.C.G., L.L., P.B., L.C.G., O.C.
	Brompton Moor	6⅛	695	P.B., L.C.G., O.C., K.R., C., U.E.S.
	Scarwell Heights	4½	400	P.B., L.C.G., O.C., K.R., C., U.E.S.
	Seamer Moor	3⅓	600	as above
W by S & W.S.W	Stoneygate Moor	10	600	M.C.G., L.L., P.B., L.C.G., O.C., K.R.
	Givendale Heights	9⅓	721	same as last
	Snainton Heights	8⅛	528	same as last
	Riggs Head, Seamer Moor	4¼	500	S. & G., L.L., P.B., L.C.G.
W.S.W & S.W. by W.	Vale of Pickering	10¾	70 to 100	K.C., W. & L.C.
	Low Yedmandale		250	S. & G., U.L., M.C.G., L.L., P.B., L.C.G.
	Box Hill		442	L.C.G.
S.W. by W. &. S.W.	Seamer Moor	3⅓	600	same as Riggs Head
	Pickering Vale	10¼		S. & G., W. & L.C.
	Irton Moor	1⅓	550	L.L., P.B., L.C.G.
S.W. & S.W. by S.	Seamer Moor	3⅓	600	see above
	West Heslerton Wold	12	625	W.C., R.C., N.C.
	East Heslerton Wold	10⅓	584	same as last
	Vale of Pickering	10¾		as above
	Seamer Moor	3½	600	as above
S.W. by S. & S.S.W.	Sherburn Wold	9¼	505	W.C., R.C., N.C.
	Vale of Pickering			see above
	Seamer Moor	3½	600	see above
S.S.W. & S. by W.	Ganton Wold	7½	500	W.C., R.C., N.C.
	Vale of Pickering			see above
	Seamer Moor	3⅓	600	see above
S. by W. & S.	Staxton Wold	6⅓	575	W.C.
	Vale of Pickering			see above
	Low Deepdale	2¾	150	see below

Direction.	Names of Heights and other natural features	Dist'ces miles.	Heights in feet.	Geological formations.
Between				
S. & S. by E.	Flixton Wold	6	511	W.C.
	Vale of Pickering			see above
	Low Deepdale	2¾	150	see below
S. by E. & S.S.E.	Folkton Wold	6	525	W.C.
	Vale of Pickering			see above
	Low Deepdale	2¾	150	N.C., U.L., M C.G., L.L. P.B.
S.S.E. & S.E. by S.	Wold west of Humanby	7	400	W.C., N.C.
	Vale of Pickering			see above
	Knox Hill	1¾	350	L.C.G , O C., K.R., C.
S.E. by S. & S.E.	Speeton Heights	8	350	N.C.
	Osgodby Hill Top	2	300	L.C.G., O.C , K R., C.
S.E. & S.E. by E.	Flamborough Head	19	150	W.C.
	Gristhorpe Cliff	5	275	D., L.C.G., O C , K.R., C., U.E.S.
	Redcliffe	4¼	280	D., L.C.G., O C., K R , C., U.E.S.
Within the Borough	Castle Hill		285	D , L L., P.B., L.C.G., O C., K R., C.
	Fault at Barbican			P.B., K.R., C.
	Castle Road Ridge, E. End	2¾		L.C.G., O C , K.R., C
	" " W.End	161		K.R , C.
	Olivers Mount		500	L.C.G.. O.C., K.R , C., U.E S.
	Spring Hill		350	K.R., C , U.E.S.
	Falsgrave Moor		508	L.C.G., O.C., K.R., C., U.E.S.

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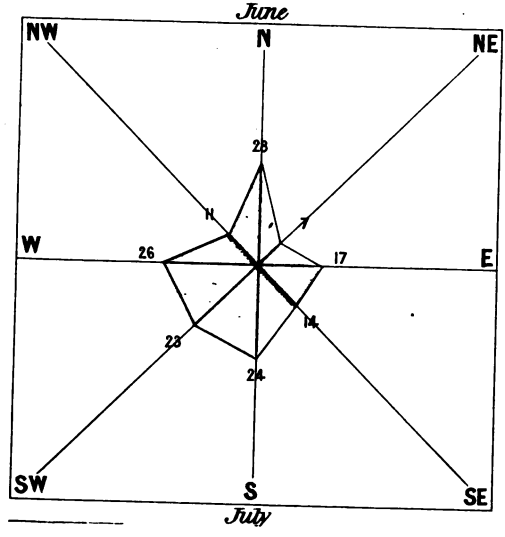
WIND CHARTS
FOR THE MONTHS;
SCARBOROUGH,
1877 – 1881.

SUMMER.